SMALL, HIGH TECHNOLOGY FIRMS, INVENTORS AND INNOVATION

HEARINGS

BEFORE THE

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INVESTIGATIONS AND OVERSIGHT

OF THE

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SMALL, HIGH TECHNOLOGY FIRMS, INVENTORS AND INNOVATION

TUESDAY, JULY 21, 1981

House of Representatives,
Committee on Science and Technology,
Subcommittee on Investigations and Oversight,
Washington, D.C.

The subcommittee met at 9:06 a.m., in room 2325 of the Rayburn House Office Building, Hon. Albert Gore, Jr. (chairman of the subcommittee) presiding.

Present: Representatives Gore, Shamansky, and Walker.

Staff present: Thomas P. Grumbly, staff director; Ray Brill, counsel; and David Clement, minority counsel.

Mr. Gore. We welcome all our guests today. I have a brief opening statement. It is not an exaggeration to say that the United States is characterized by its inventors—the Franklins, the Jeffersons, the Edisons, as well as by individual entrepreneurs who paved the frontiers of the West.

In reducing this phenomenon to statistics, a 1977 U.S. Commerce Department study noted that technological innovation was responsible for 45 percent of the Nation's economic growth from 1929 to 1969. And yet we now hear repeatedly about the lagging U.S. rate of productivity and innovation. The Congressional Budget Office recently released figures that show our average rate of growth in labor productivity in the private sector has decreased from 3.5 percent in the 1957-69 time period to 0.64 in the 1973-80 time period. Recent figures are even worse.

Our patent statistics are also disturbing. In 1960, 49,986 patents were granted by the United States, of which 16 percent were granted to foreigners. In 1979, 52,411 patents were granted by the United States, of which 37 percent were granted to foreigners. This trend is even more disturbing when one considers that foreigners receive 60–95 percent of patents in many important and active fields.

I am convinced that the solution to this problem is to unleash the entrepreneurial spirit that abounds in our country. A 1977 report published by the U.S. Office of Federal Procurement Policy indicated that small firms with less than 1,000 employees accounted for almost one-half of the major innovations during the 1953–73 time period. Independent inventors have made some of the major innovations of the 20th century, including the vacuum tube, xerography, penicillin, catalytic cracking of petroleum, jet engine, the cyclotron, rockets, polaroid camera, tungsten carbide, and bakelite. That is but part of an impressive list.

This subcommittee has had a longstanding interest in innovation and I will use, as its latest chairman, every possible means at my disposal to insure that all unreasonable barriers to innovation are removed. We must encourage the small, high technology firms and independent inventors to produce the new technology which will fuel the reindustrialization of America. That is why we are here today and this hearing is so timely and vital.

Today we will hear about private programs designed to increase technological innovation through small, high technology firms and independent inventors. Tomorrow we will hear from three Federal agencies, NSF, SBA, and DOE/NBS about their programs to stimulate innovation.

Today, we will hear from four panels. The first panel will discuss the importance of technological innovation to our country and the role small, high technological firms and independent inventors have played despite many barriers that confront them.

Our second panel will discuss the large corporation/small firm/independent inventor interface. We are pleased to have Arthur D. Little, Inc. and Control Data here today as both corporations are leading the way to promote innovation.

The third panel consists of two university innovation centers, one at the Wharton School in the University of Pennsylvania and the other at Georgia Tech. Universities combine the technical and business skills to assist the inventor and small firm at the earliest stages of prototype development and market analysis.

The fourth panel consists of two venture capitalists, one representing Technology Partners in Chicago and the other representing International Technology Resources, Inc. in New York. Most inventors and startups rely on their personal savings, family, friends or local wealthy investors to finance prototype development. Venture capital firms generally invest 25-30 percent of their capital in startups, but shy away from preprototype funding because it is so risky. This seed capital is nonetheless important and relatively new.

As an innovative approach to these hearings on innovation, we have invited a distinguished panel of inventors and chief executive officers of high technology firms who are literally on the firing line to interact with each panel at the conclusion of his oral statement. It should result in a most informative interchange.

It is my hope that this hearing will form only the overture of a continuing effort by this committee to spotlight and focus upon problems and opportunities which surround the returning the United States to its place among the great innovative nations of the world. The Jeffersons and the Edisons are no doubt still among us. We have only to reach out and rescue them from the regulatory underbrush and the frantic rush of modern society.

I would like to call upon our ranking minority member, Mr. Walker.

Mr. **Walker**. Thank you, Mr. Chairman. I would certainly like to go along with the statement that you have just made. I think it represents the kind of thrust that we want these hearings to take. I have no further statement. I look forward to the hearing.

Mr. **Gore**. Our first panel is Dr. Edwin Mansfield, with the University of Pennsylvania; Dr. Aaron Gellman, president of Gellman Research; and Professor Albert Shapero, from Ohio State University.

Gentlemen, we are delighted to welcome you here today. Without objection, the entire text of your prepared statements will be included in the record. We invite you to proceed with the presentation of any or all of your statement as you see fit. We would like to begin with you, Dr. Mansfield.

[The biographical sketch of Dr. Mansfield follows:]

Dr. Edwin Mansfield

Edwin Mansfield was born in Kingston, New York, on June 8, 1930. He received an A.B. from Dartmouth College in 1951, an M.A. from Duke University in 1953, and a Ph.D. from Duke University in 1955. During 1954-55, he studied at the University of London and received the Certificate and Diploma of the Royal Statistical Society in 1955. In 1971, he received an honorary Master of Arts from the University of Pennsylvania.

From 1955-63, he was Assistant Professor of Economics and Associate Professor of Economics at the Graduate School of Industrial Administration at Carnegie Institute of Technology. In addition, he was Director of Carnegie's research program on technological change and economic growth. During 1961-62, he was Visiting Associate Professor of Economics at Yale University. During 1963-64, he was Visiting Professor of Economics at Harvard University. During 1967-68, he was Visiting Professor of Economics at California Institute of Technology. In 1963, he was appointed Professor of Economics at the Wharton School of the University of Pennsylvania.

In 1979, Mansfield was elected to the American Academy of Arts and Sciences. In 1979, he was the first American economist invited by the People's Republic of China to lecture there under the Sino-American scientific exchanges. During 1974-75, Mansfield served as U.S. Chairman of the U.S.-U.S.S.R. Working Party on the Economics of Scientific Information. In 1971-72, he was a Fellow at the Center for Advanced Study in the Behavioral Sciences at Stanford. He received a Fulbright Fellowship in 1954-55 and a Ford Foundation Faculty Research Fellowship in 1960-61. He was elected a Fellow of the Econometric Society in 1969, and is a member of the American Economic Association, Delta Upsilon, and Phi Beta Kappa. He was Associate Editor of the Journal of the American Statistical Association from 1964-67, and has been an associate editor of the *American Economist* since 1969. In 1981, he gave the Andersen Lectures at the University of Brussels.

Mansfield is a member of the Committee on Science, Engineering, and Public Policy of the American Association for the Advancement of Science. He is, and has been, a consultant to many government and other organizations, such as the RAND Corporation, the National Science Foundation, the Federal Power Commission, the U.S. Army, the Small Business Administration, the President's Commission on Government Procurement, the Institute for Defense Analyses, and the President's Commission on Automation. He was a member of the Advisory Committee on Planning of the National Science Foundation from 1967-1970, and a member of the Governor's Science Adviery Committee. Also, he was a member of the Ford Foundation's Committee on the Economics of Technological Change from 1963 to 1967, and the National Academy of Science's Evaluation Panel for the National Bureau of Standards. In 1979, he received the Certificate of Appreciation from the U.S. Secretary of Commerce.

Mansfield has published 19 books, including *Industrial Research and Technological Innovation* (W.W. Norton for the Cowles Foundation for Research in Economics at Yale University, 1968), *The Economics of Technological Change* (W.W. Norton, 1968), *Microeconomics: Theory and Applications*, Third edition, (W.W. Norton, 1979), *Research and Innovation in the Modern Corporation* (W.W. Norton, 1971), *Economics*, Third edition, (W.W. Norton, 1980), *The Production and Application of New Industrial Technology* (W.W. Norton, 1977), *Monopoly Power and Economic Performance*, Fourth edition (W.W. Norton, 1979), *Managerial Economics and Operations Research*, Third edition (W.W. Norton, 1974), and *Defense, Science, and Public Policy*. Also, he is the author of over 100 articles dealing with economics, statistics, and operations research, many of which appear in the *American Economic Review*, *Journal of Political Economy*, *Review of Economics and Statistics*, *Econometrica*, *Journal of the Royal Statistical Society*, *Management Science*, *Journal of Business*, and *Quarterly Journal of Economics*. In addition, he is author of the article on "Industrial Research" in the *Encyclopedia Britannica*.

STATEMENTS OF DR. EDWIN MANSFIELD, PROFESSOR OF ECONOMICS, UNIVERSITY OF PENNSYLVANIA; DR. AARON GELLMAN, PRESIDENT, GELLMAN RESEARCH; AND ALBERT SHAPERO, PROFESSOR OF MANAGEMENT SCIENCES, OHIO STATE UNIVERSITY

Dr. **Mansfield**. Thank you very much, Congressman Gore.

I have been asked to describe very briefly the role and importance of technological innovation in the American economy, which is obviously a considerable task, particularly in 10 minutes.

Technological change consists of advances in knowledge concerning the industrial, agricultural and medical arts. Such advances result in new and improved processes and products as well as new techniques of organization and management. The fact that technological change plays an important role in permitting and stimulating the growth of per capita output seems self-evident, but when one wants to go beyond such bland generalizations to a quantitative summary of the contributions of technological change to the rate of economic growth, a number of basic difficulties are encountered.

For one thing, it is hard to separate the effects on economic growth of technological change from those of investment in physical capital since, to be used, new technology frequently must be embodied in physical capital, that is, new machines and plant. Nor can the effects of technological change easily be separated from those of education since the social returns from increased education are enhanced by technological change and the rate of technological change is influenced by the extent and nature of society's investment in education.

Despite these and other problems, economists have tried to obtain quantitative measures of the importance of technological change to American economic growth. For example, Edward Denison, formerly of Brookings, and now with the Department of Commerce, concluded that the advance of knowledge is responsible for about 40 percent of the total increase in national income per person employed in the United States during 1929 to 1957.

To quantify the effects of technological innovations on the economy, economists have devoted considerable attention to the estimation of the social rates of return from technological innovations, the social rate of return being analogous to the rate of return earned on a private investment. Specifically, the social rate of return is the interest rate received by society as a whole from the investment in a new technology. Of course, there are many problems in measuring the social rate of return from an investment in new technology. Nonetheless, assuming that the innovation is basically resource saving in nature, a technique has been devised to provide at least rough estimates of an innovation's social rate of return. This technique has been used to obtain published estimates of the social rate of return for about 100 innovations.

The results of these studies, although obviously tentative, seem to be interesting from the point of view of public policy. First, the social rates of return tend to be very high indicating that if these innovations are at all typical, investments in new technology have paid off handsomely to society at large. For example, one study of 17 industrial innovations, most of which were minor, not major improvements, found that the median social rate of return from the investments in these innovations exceeded 50 percent.

Second, the private rates of return from investments in new technology—in other words, the rate of return to the innovators, to the firms that put up the money for the innovations—seem to be lower than the social rate of return. For example, among the 17 innovations cited above, the median private rate of return was about 25 percent.

Third, in about 30 percent of the cases in this sample, the private rate of return was so low that no firm with the advantage of hindsight would have invested in the innovation. But the social rate of return from the innovation was so high that from society's point of view, the investment was well worthwhile. Although this evidence is very limited and by no means unambiguous, it seems to suggest that there may be an underinvestment in certain areas of civilian technology.

Let me turn to inflation, which is clearly one of the most serious problems facing the American economy. Via its effect on productivity, innovation tends to reduce inflation at least in the medium and long run. Total cost per unit of output equals total cost per hour of labor divided by output per hour of labor. Thus, the rate of increase of total cost per unit of output equals the rate of increase of total cost per hour of labor minus the rate of increase of labor productivity. This is merely an identity. If the rate of increase of labor productivity—that is, output per hour of labor—is high, the rate of increase of total cost per unit of output will be much lower than the rate of increase of total cost per hour of labor. But if the rate of increase of labor productivity is low, the rate of increase of total cost per unit of output will be almost as great as the rate of increase of total cost per hour of labor.

Now, this exercise in arithmetic is of some importance in understanding recent inflation. Of course, factors other than the slowing of our rate of productivity growth have been of major consequences in accounting for the excessive recent rates of inflation in the United States. But this factor nonetheless has been an important one.

Besides affecting productivity and economic growth, as well as the rate of inflation, technological innovation influences how competitive American firms are in world markets. In many areas where we have a favorable balance of trade, our comparative advantage seems to be based on a technological edge. In R. & D. intensive manufacturing industries such as nonelectric machinery, aircraft, chemicals, electrical equipment and instruments, the United States has maintained a favorable balance of trade for many years.

On the other hand, in non-R. & D. intensive manufacturing industries, the United States has experienced a very large negative trade balance in the past decade. Of course, many factors such as exchange rates, tariffs, quotas, and the aggressiveness and effectiveness with which firms try to market their products abroad influence our trade position. But there seems to be widespread agreement among economists and others that the role of technology in U.S. foreign trade is very important.

In conclusion, the early eighties have been a period of reexamination of the American economy. Beset by extremely high rates of inflation, high rates of unemployment, deficits in our balance of trade, basic structural problems in major industries like steel and autos, and very low rates of productivity increase, the American economy, long the engine on which our people, and to some extent other peoples as well, could count for material progress, has seemed to be in trouble. Whether this trouble will prove only temporary depends upon the policies adopted by our Government, the actions taken by our firms and the attitudes of our people.

The policies, actions and attitudes required to revitalize the American economy are of many types. Proper monetary and fiscal policies are essential. So is proper attention by firms to long-range objectives and to such apparently mundane matters as quality control. In reacting to our current problems, it is very important too that policymakers both in the public and private sectors recognize the central role played by technology.

As pointed out above, it has been estimated that 40 percent or more of the long-term increase in output per person employed in the United States has been due to technological change. While estimates of this sort are subject to many, many limitations, it certainly is true that technological change has been responsible for a substantial share of our past productivity growth. Moreover, as indicated above, the rate of innovation in the United States has an important influence on the competitiveness of U.S. goods in the world markets and on our rate of inflation. Thus, there can be little question concerning the significance of technological innovation to the American economy.

Thank you.

[The prepared statement of Dr. Mansfield follows:]

IMPORTANCE OF TECHNOLOGICAL INNOVATION TO THE AMERICAN ECONOMY

Testimony before the Committee on Science and Technology,
U.S. House of Representatives, July 21, 1981

Edwin Mansfield
University of Pennsylvania

1. Introduction

I have been asked to describe very briefly the role and importance of technological innovation in the American economy. To begin with, I'll define technology and innovation. Then I'll try to indicate the relationships between technological innovation, on the one hand, and our nation's rate of economic growth, inflation rate, and international competitiveness, on the other.

2. Technological Change and Innovation

Technology consists of society's pool of knowledge concerning the industrial, agricultural, and medical arts. It is made up of knowledge concerning physical and social phenomena, knowledge regarding the application of basic principles to practical work, and knowledge of the rules of thumb of practitioners and craftsmen. Although the distinction between science and technology is imprecise, it is important. Science is aimed at understanding, whereas technology is aimed at use. Changes in technology often take place as a consequence of inventions that depend on no new scientific principles. Indeed, until the middle of the nineteenth century, there was only a loose connection between science and technology. However, in recent years, technology has come to be much more closely intertwined with science.

The fundamental and widespread effects of technological change are obvious. Technological change has permitted the reduction of working hours, improved working conditions, provided a wide variety of extraordinary new products, increased the flow of old products, and added a great many dimensions to the life of our citizens. At the same time, technological change also has its darker side. Advances in military technology have enabled modern nation-states to cause human destruction on an unprecedented scale, modern technology has contributed to various kinds of air and water pollution, and advances in industrial technology have sometimes resulted in widespread unemployment in particular occupations and communities. Despite the many benefits that society has reaped from technological change, no one would regard it as an unalloyed blessing.

A technological innovation is defined as the first commercial introduction of new technology. Research and development is only a part of the process leading to a successful technological innovation. The first part of this process takes place in the interval between the establishment of technical feasibility and the beginning of commercial development of the new product or process. This time interval may be substantial (although it is shorter now than 50 years ago). For example, it often was about a decade for important postwar innovations, like numerical control, freeze-dried food and integrated circuits. The second part of this process takes place in the time interval between the beginning of commercial development and the first commercial application of the new process or product. This time interval contains a number of distinct stages--applied research, preparation of product specification, prototype or pilot plant construction, tooling and construction of manufacturing facilities, and manufacturing and marketing startup. In all, this time interval has often been about five years for important postwar innovations.

3. Technological Change and Economic Growth

Technological change consists of advances in knowledge concerning the industrial, agricultural, and medical arts. Such advances result in new and improved processes and products, as well as new techniques of organization and management. The fact that technological change plays an important role in permitting and stimulating the growth of per capita output seems self-evident. But when one wants to go beyond such bland generalizations to a quantitative summary of the contribution of technological change to the rate of economic growth, a number of basic difficulties are encountered. For one thing, it is hard to separate the effects on economic growth of technological change from those of investment in physical capital, since, to be used, new technology frequently must be embodied in physical capital--new machines and plant. For example, a numerically controlled machine tool (or control mechanism) must be built to take full advantage of some of the advances in the technology related to machine tools. Nor can the effects of technological change easily be separated from those of education, since the social returns from increased education are enhanced by technological change, and the rate of technological change is influenced by the extent and nature of society's investment in education.

Despite these and other problems, economists have tried to obtain quantitative measures of the importance of technological change in American economic growth. In a seminal article published in 1957, Robert Solow attempted to estimate the rate of technological change in the nonfarm U.S. economy from 1909 to 1949. His findings indicated that, for the period as a whole, the average rate of technological change was about 1.5 percent per year. Based on these findings, he concluded that about 90 percent of the increase in output per capita during that period was attributable to technological change, whereas only a minor percentage of the increase was due to increases in the amount of capital employed per worker.

Solow's measure of the effects of technological change also included the effects of whatever inputs were excluded, such as increases in education or improved health and nutrition of workers, as well as economies of scale, improved allocation of resources, and changes in product mix. To obtain a purer measure, Edward Denison attempted to include many factors--for example, changes in labor quality associated with increases in schooling--that had been omitted, largely or completely, by Solow and others. Since Denison's study was relatively comprehensive, it resulted in a lower residual increase in output unexplained by the inputs he included than did Solow. Specifically, Denison concluded that the advance of knowledge--his term for the residual--was responsible for about 40 percent of the total increase in national income per person employed during 1929-57 in the United States.

4. Rates of Return from Investments in Innovation

To quantify the effects of technological innovations on the economy, economists have devoted considerable attention to the estimation of the social rates of return from technological innovations, the social rate of return being analogous to the rate of return earned on a private investment. Specifically, the social rate of return is the interest rate received by society as a whole from the investment in a new technology. Of course, there are many problems in measuring the social rate of return from an investment in new technology. Any innovation, particularly a major one, has effects on many sectors of the economy, and it obviously is very hard to evaluate and summarize these effects. Nonetheless, assuming that the innovation is basically resource-saving in nature, a technique has been devised to provide at least rough estimates of an innovation's social rate of return. This technique has been used to obtain published estimates of the social rate of return for about 100 innovations.

The results of these studies, although obviously tentative, seem to be interesting from the point of view of public policy. First, the social rates of return tend to be very high, indicating that, if these innovations are at all typical, investments in new technology have paid off handsomely to society at large. For example, one study of 17 industrial innovations--most of which were minor, not major improvements--found that the median social rate of return from the investments in these innovations exceeded 50 percent. Second, the private rates of return from investments in new technology seem to be lower than the social rate of return. For example, among the 17 innovations cited above, the median private rate of return was about 25 percent. Third, in about 30 percent of the cases in this sample, the private rate of return was so low that no firm, with the advantage of hindsight, would have invested in the innovation, but the social rate of return from the innovation was so high that, from society's point of view, the investment was well worthwhile. Although this evidence is very limited and by no means unambiguous, it seems to suggest that there may be an underinvestment in certain areas of civilian technology. Obviously, however, the available data are too sparse to indicate where the shortfall--if one exists--is greatest, but for what it may be worth, the gap between private and social rates of return seems to be relatively large for more important innovations and for the innovations that can be imitated relatively cheaply by competitors. (See Mansfield et al. (1977).)

5. Innovation and Inflation

Inflation clearly is one of the most serious problems facing the American economy. Via its effect on productivity, innovation tends to reduce inflation, at least in the medium and long run. Total cost per unit of output equals total cost per hour of labor divided by output per hour of labor. Thus, the rate of increase of total cost per unit of output equals the rate of increase of total cost per hour of labor minus the rate of increase of labor productivity. If the rate of increase of labor productivity (i.e., output per hour of labor) is high, the rate of increase of total cost per unit of output will be much lower than the rate of increase of total cost per hour of labor. But if the rate of increase of labor productivity is low, the rate of increase of total cost per unit of output will be almost as great as the rate of increase of total cost per hour of labor. Of course, factors other than the slowing of our rate of productivity growth have been major culprits responsible for the excessive recent rates of inflation in the United States. But this factor nonetheless has been an important one.

To illustrate how innovation exerts a restraining influence on inflation, consider petroleum refining. According to a careful study by John Enos, the cost of enough gasoline for 100 ton-miles of transportation would have been $1.47 in 1955 if the Burton process had still been used. Instead, because of a number of major cracking innovations, the actual cost was only 26 cents. Or take the case of ammonia production. The development and introduction of large-scale ammonia plants in the Sixties reduced the cost of ammonia by over 20 percent, according to SRI International. These are not isolated cases. In any R and D-intensive industry, it is relatively easy to find illustrations of this sort.

6. Innovation and U.S. Competitiveness in World Markets

Besides affecting productivity and economic growth, as well as the rate of inflation, technological innovation influences how competitive American firms are in world markets. Although economists have been aware for over a century that technological change is one determinant of the nature and size of a country's imports and exports, there has been increasing emphasis on this factor in the past 10 or 15 years. Both from case studies and statistical analyses, economists have found that U.S. industries that spend relatively large amounts on R and D are the ones that lead in manufactured exports, foreign direct investment and licensing. Needless to say, there is an enormous amount that remains to be learned concerning the relationship between technological change and our foreign trade. But the available evidence seems to suggest that technological innovation has had a major influence on American exports, receipts from licenses, and direct investment abroad.

In many areas where we have a favorable balance of trade, our comparative advantage seems to be based on a technological edge. In R and D-intensive manufacturing industries, such as nonelectric machinery, aircraft, chemicals, electrical equipment, and instruments, the United States has maintained a favorable balance of trade for many years. On the other hand, in non-R and D-intensive manufacturing industries, the United States has experienced a very large negative trade balance in the past decade. Of course, many factors--such as exchange rates, tariffs, quotas, and the aggressiveness and effectiveness with which firms try to market their products abroad--influence our trade position. But there seems to be widespread agreement among economists and others that the role of technology in U.S. foreign trade is important.

Although it is very difficult to measure international differences in technological levels, the available evidence suggests that the United States long has been a leader in technology. But in the past 15 or 20 years, the U.S. technological lead has been reduced in many areas; in some areas, it no longer exists at all, according to the judgment of many leading engineers, scientists, and managers. Obviously, this has had, and will have, an important effect on our trade position in many major industries. (See Mansfield et al. (forthcoming).)

7. Conclusions

In conclusion, the early 1980s have been a period of reexamination of the American economy. Beset by very high rates of inflation, high rates of unemployment, deficits in our balance of trade, basic structural problems in major industries like steel and autos, and very low rates of productivity increase, the American economy, long the engine on which our people (and to some extent other peoples as well) could count for material progress, has seemed to be in trouble. Whether this trouble will prove only temporary depends upon the policies adopted by our government, the actions taken by our firms, and the attitudes of our people. The policies, actions, and attitudes required to revitalize the American economy are of many types. Proper monetary and fiscal policies are essential. So is proper attention by firms to longer-range objectives and to such apparently mundane matters as quality control.

In reacting to our current problems, it is very important that policy makers, both in the public and private sectors, recognize the central role played by technology. As pointed out above, it has been estimated that 40 percent or more of the long-term increase in output per person employed in the United States has been due to technological change. Although estimates of this sort are subject to many limitations, it certainly is true that technological change has been responsible for a substantial share of our past productivity growth. Moreover, as indicated above, the rate of innovation in the United States has an important influence on the competitiveness of U.S. goods in world markets and on our rate of inflation. Thus, there can be little question concerning the significance of technological innovation to the American economy.

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Mr. **Gore**. Thank you for that fascinating overview, Dr. Mansfield.

The subcommittee considers you one of the two leading experts in this field. We are delighted to have you here.

Dr. Gellman, we would like to hear from you next. You have been looking at this issue at least since 1967. We are most honored to have you with us on this occasion.

Dr. **Gellman**. Thank you very much, Mr. Gore. It is a pleasure to be here. I think there is ample evidence to advance with some vigor the hypothetical that small enterprise is very important in general to economic well-being and development in the United States and that high technology or technology-rich small enterprise has a very special place, special role to play. Indeed, Professor Mansfield set the stage very well for that observation.

We can go back to Schumpeter, the famous economist, or even further. Joseph Schumpeter spoke eloquently about the "rise of new men" and he spoke of inventors and entrepreneurs when he used that phrase. It is difficult to imagine that there was ever a more important period in American history to encourage the use of such new men than there is today.

One of the tragedies of our times in terms of small enterprise is the lack of data to tell us with the required precision what the role of small enterprise in high technology is in the United States. Part of the tragedy—or one of the reasons that I consider it to be a tragedy of some importance—is that there are quite a lot of raw data that can be massaged, can be treated to gain insights beyond that which we already have. As an illustration of that point, and also to indicate in another way, and I think a new way, the importance of small high-technology enterprise, I would just share with you a few conclusions that will be published very soon from a study we are in the process of completing for the Small Business Administration.

The title of this study is "The Relationship Between Industrial Concentration and Technological Innovation." It holds that small firms produce significantly more innovations per employee than do large firms. This is drawn from a different set of data than had previously been used and supports that hypothetical about the crucial importance of small firms on a macroeconomic level.

Second, the importance of small firm innovation as measured by technical and economic significance are approximately equal to those of large firms. Small firms bring their innovations to market much more rapidly than do large firms. They tend to pass more rapidly than large firms through this process we call innovation from ideation or conception on the one hand to market introduction in an arm's length transaction at the other end. In highly concentrated industries, small firms tend to innovate, to generate the raw materials and indeed, carry those exploitable raw materials forward into innovation more often based on the number of people employed than do large firms in concentrated industries. In concentrated industries, the corollary is that larger firms tend to innovate below expectation, with "expectation" being defined quite precisely in the study.

Larger firms in concentrated industries tend to acquire more of their innovations from other firms than do smaller companies; that is, large enterprises in concentrated industries more often tend to acquire the raw materials for their innovations from smaller companies, either by acquiring the small enterprise or by licensing or some other appropriate arrangement.

This leads to a hypothesis that I think is of extreme importance and which has rarely been advanced; namely, that what is good for small enterprise, particularly small technological enterprise in the United States, happens to be good for large enterprise as well.

One of the things which surprises me every time I get involved in this field is how few large enterprises support small enterprise explicitly, either through helping Congress understand the problem or taking explicit actions to support small enterprise themselves. It is not surprising, for example, that I find Control Data here today. They are one of the exceptions to the rule. But there should be so many large enterprises explicitly interested in this that Control Data's commitment should not be exceptional. I think that is a very important point. And the situation can be helped by some actions that Congress might take, which I will come to shortly.

The policy implications of what I just said include several, of which here are three. Given the fact that small firms appear to be more efficient than large firms in the way they use the R. & .D funds available to them, since we are finding that small firms innovate at a higher rate per employee; for example, there is an indication that funding of small-firm R. & D. is more cost effective than large-firm R. & D., at least under many circumstances. The cost effectiveness of investment in small firms is further enhanced by the fact that innovations seem to be brought to market sooner than those emanating from larger firms, as I earlier observed.

R. & D. in concentrated industries should be directed to smaller firms where the economic performance appears far better than the that of the larger firms.

Now, with time short, I would like to make a couple of general points and then four specific suggestions for improving the environment for small, high-technology enterprises. You have perhaps noted that I use the term "small enterprise," more often than "small business". The reason is that I believe we have come to see the term "small business" applied to what we consider manufacturing and distribution-type firms. By "enterprise," I think we want to convey two things in addition to that: First, small agricultural enterprises which are not often thought of as businesses though they are indeed that, and second, the small public enterprise, the small airport, the small hospital. Our country is increasingly finding itself reliant on public enterprise and among the public enterprises are a growing number of small public enterprises. I think we ought to recognize that many of the problems small public enterprise faces are not unlike those of small private enterprise.

I think we need to have a much broader understanding, also, that innovation that is "high technology," that is R. & D.-intensive, often requires the support of small enterprises that may not themselves be R. & D.-intensive. There are many services to be provided in support of high-technology innovation that small enterprises are especially well-equipped to provide. In addition, there are small enterprises that, in support of high-technology innovation, can produce support or service activities that are not very technological at base under any definition.

So, we want to recognize the complexity of the process of innovation and indeed the support that small enterprise can provide all along the line and in all degrees of technology intensity.

Let me return to one point that I made before, adding one more point, namely, that there is a community of interest between small and large enterprise in this country and that it exists and has been demonstrated repeatedly. One of the most interesting ways to see this is by looking at certain industries and considering that each industry has a certain amount of preeminence, let us call it, and a certain amount of predominance in world markets.

By "preeminence," I mean to convey the intellectual capability to address the market and by "predominance," I mean basically share of the market enjoyed. Much research suggests that small enterprise is often more efficient in the exploitation of technology but that larger enterprises are more efficient in exploiting some markets which need such technology. We need to maintain preeminence in many fields where we also want to be predominant. It is possible to separate the two and we must do so to develop the proper public policy conclusions. Among such conclusions is that small and large firms may often have to work together in vertical arrangements in terms of the process of innovation in order for both to be successful and for U.S. preeminence and predominance to be established and maintained.

Let me conclude by making several specific suggestions. One of the most powerful things, it seems to me, that can be done to support high-technology small enterprises is to require that purchases made with Government funds, with Federal funds, State funds, whatever—that such purchases wherever possible, be carried out on a performance basis rather than on a design basis. That is, performance specification purchasing will introduce small enterprises into markets where they have been effectively barred by the overreliance on design specifications. I invite you to analyze, in terms of Federal procurement, one specific case in point: The FAA's method of procurement where they rely in the high technology area almost totally on design specifications. Talk to small entrepreneurs who would like to respond to FAA's needs, but can't meet the design requirements. They could help FAA move technology much further than the traditional design-oriented suppliers to FAA have been able to do.

Mr. SHAMANSKY. You are asking us to ask that question? What do you think? Why is that?

Dr. GELLMAN. I think there are two or three fundamental reasons for that. One is that I do not believe most Government agencies with substantial resources devoted to buying goods and services understand the potential of the small enterprise contribution to efficiency and innovation. I think there is a woeful ignorance of the differences between small and large enterprises in these settings where hardware and software are being acquired. I think this is true through most of the Federal Establishment and certainly through the purchasing agencies thereof.

The second is I do not think the process of technological innovation, especially on the high-technology side is very much understood by public agency officials.

Mr. SHAMANSKY. Do you think it is understood in private?

Dr. GELLMAN. It is not well enough understood in private, but a lot better understood in private than in public. Indeed, one of the unfortunate things we have found is that in procurement operations and the functions tied to them, such as the engineers that write the specs and so on, very few people in the public sector understand the free enterprise system and how investment decisions are made in the private sector. I marvel and blanch at the same time at how we go on forward with such ignorance rampant on the part of people with so much purchasing money.

Mr. SHAMANSKY. Whose fault is that?

Dr. GELLMAN. I think that is the fault of a succession of administrations.

Mr. SHAMANSKY. How about the market? We are a market-oriented society. Don't they have a reason to educate the public, a responsibility?

Dr. GELLMAN. Many enterprises serving the public sector have attempted to explain the process of innovation to all their potential and actual customers.

Mr. SHAMANSKY. How does that manifest itself?

Dr. GELLMAN. I think it manifests itself in the form of publications, in the form of speeches, in the form of people calling on procurement and engineering people throughout the Government establishments to try to explain why you need to do this to get from here through the process of innovation to there.

Mr. SHAMANSKY. If you say the people have the greatest motivation to do so, the private sector hasn't succeeded in educating, why would you think that the bureaucracy would be able to?

Dr. GELLMAN. I have never served as a Federal employee except in uniform and that certainly didn't prepare me to answer this question from personal observation. But I do believe that one of the roles that the Small Business Administration should have been playing and I think has played very little is in fact to educate government procurement people with regard to the effective, beneficial use of their purchasing power—for example how much more they can get out of a dollar with small enterprizes compared with large in many areas. FAA happens to be one I am reasonably familiar with but there are others I am sure.

I think the SBA could have done and indeed should be doing a somewhat more effective job in making small business efficiency, as it were, better known and better understood in the Federal procurement establishment.

I also believe that private industry warrants criticism being hurled at it. Indeed, however, it should be clear that where design specifications are employed primarily as the procurement technique, the large entrenched firm really cannot have much interest in educating the procurement people to the power of the performance specification to bring competitors in against itself.

So, I on further reflection, I do not expect that large, entrenched enterprises are very often going to try to educate public procurement people.

Mr. SHAMANSKY. You can apply that analogy to the automobile industry; can't you?

Dr. GELLMAN. I suppose so. I believe that is probably a good analogy. I would have to think about it some more. But it seems sensible to me. By the way, this business of design and performance specifications is not nearly as well understood as it ought to be in any sense, in my judgment. There is no burden of proof that a design specification should not be used and a performance specification should be used, either explicitly or implicitly, in public procurement or in private procurement in most companies, either.

I think, however, that the performance spec is a very powerful tool to improve the innovative performance of the American economy which has special relevance here given the very substantial amount of funds that are in the hands of government for purchasing purposes in the United States.

Mr. SHAMANSKY. You are flanked by two academics. Are you satisfied that the business schools are doing their share?

Dr. GELLMAN. I should warn you, sir, that I am an adjunct professor at the Wharton School at Pennsylvania.

Mr. SHAMANSKY. Since we have a panel of three academics, what are you guys doing?

Dr. GELLMAN. Earlier I referred to Professor Schumpeter who was an academic; he cried in the wilderness about much of this as far as the private sector is concerned for many decades. I think the academic community has too few people who understand the process of innovation, too. But the few are trying.

Mr. SHAMANSKY. I know the gentleman on your left. I know he knows.

Dr. GELLMAN. Yes. I have known him for a long time. I know he knows for two reasons, not the least of which is the fact he has been out there in the real world I think it is important, and it incidentally relates to one of the other suggestions that I have that relates to education.

I will jump to that to save time because it is consistent with your question. I think there is a role that the government can play with regard to education for entrepreneurship, education for small enterprise careers. Let me give you the two things that I think need to be done in very general terms.

One, I do not believe that in secondary education in this country when children, high schoolers, kids, when young people at that level of their education are considering what they are going to do with their lives from a career standpoint, I believe they are not given sufficient information and sufficient inducement to think about small enterprise kinds of careers whereas the large enterprise kind of career is indeed avanced to them as a possibility.

It is on their menu. The small enterprise career per se is not very often on the menu at the secondary level. I think there are a number of ways that public education could be induced to deal with that problem, which is a very low cost problem to solve with a very high payoff inherent in it.

Second, in terms of education, I believe there should be curriculum materials developed to assist certainly in the MBA type environment but perhaps in undergraduate levels, too, and particularly in engineering schools—to assist people in understanding the problems of small enterprise and help them recognize those problems and also point the directions toward solutions.

I don't think we have much in the way of special attention paid to the management training aspects of small enterprise. I feel this very strongly. In the private sector, if large companies recognized their community of interest with small enterprises, I think they would find it prudent to contribute greatly to reorienting the education process, through intellectual resources, if not capital.

Another matter that was the second element of the purchasing issue, I would just like to mention in passing because I do think it has importance. I don't know how much of it is direct economic importance but I think it has some psychological importance which results in economic importance as well.

We have some screwy concepts antitrust—not only laws—that go against small enterprise in a very important way for certain types of small enterprise such as consulting and other research-related firms. Let me be specific. Robinson-Patman is held not to apply to services. I my consulting firm, which was 20-some people at the time we sold our firm to a very large company, our car rental and hotel bills went down 35 or more percent instantaneously with the sale. I can assure you that the hotel chains and the auto rental companies bear more cost in serving us now than they did before because now they have to look up what the discount structure is for our particular parent, and so forth.

This sort of thing is highly discriminatory against small enterprise. There ought to be a search through the economy, if you will, to see where these kinds of nonsensical situations exist and, in fact, do discriminate against small enterprise—discriminate in a legal sense or in the more relevant sense which is the economic sense.

This sort of volume discounting without economic justification is unconscionable and it goes on every day. I think it ought to be stopped even though I am currently the beneficiary of that discrimination. That is a purchasing sort of problem of the more mundane sort.

A more thorny problem for the public sector to deal with relates to the small R. & D. firm. I am not convinced that the public is well served or the economic development of this country is well served by the U.S. Government's funding so heavily enterprises that do research and development and only research and development.

I am not sure we are ill served, I just don't know.

But then again, nobody else appears to know, either. Probably there is much talent, entrepreneurial talent, locked up in these small R. & D. firms—talent which is sufficient to get them to the marketplace with an R. & D. result other than a research report. The only goal for them now is an intermediate product—an R. & D. report. I am not sure that anybody's interest is well served if we overuse talented, high-technology enterprises to produce only R. & D. results which when, delivered to the Government customer, may or may not be exploited in the marketplace.

Such firms that have no commitment to go to the market in exploiting their promising R. & D. results, it seems to me, are the sound of one hand clapping: they don't do much for the economy.

Mr. **Shamansky**. Excuse me, Doctor. You are eluding me here. Maybe I don't have enough business background. You have R. & D. firms who have contracts to do what?

Dr. **Gellman**. Produce R. & D. results.

Mr. **Shamansky**. For whom?

Dr. **Gellman**. Government primarily.

Mr. **Shamansky**. Why does the Government ask them to do it?

Dr. **Gellman**. The Government defines an R. & D. need.

Mr. **Shamansky**. You mean to say someone in the Government has an idea they want an R. & D. result on with no end product except the mere existence of the R. & D. report?

Dr. **Gellman**. That has happened.

Mr. **Shamansky**. Is that the norm?

Dr. **Gellman**. I would say when the R. & D. contract is let, when the procurement of the report cycle is started, there is usually in mind a specific technique for producing a product or service that gets to some market.

But more often than not, I think it is fair to say, the post R. & D. report activities are thwarted or are exploited very slowly and indeed, we don't get much as a country out of R. & D. results of this sort.

Mr. **Shamansky**. Aren't those things available to the public?

Dr. **Gellman**. Yes; but you have another set of problems like exclusivity. When the Government pays for the study, it obtains either exclusive or nonexclusive rights to the technology and there are problems for entrepreneurs who might want to exploit the technology.

Mr. **Shamansky**. Wouldn't that be a marvelous opportunity for some entrepreneurs to get that stuff and do something with it?

Dr. **Gellman**. I agree. What you are saying is we need to know how much of a barrier it is, in fact, that the Government maintains at least nonexclusive, royalty free use to R. & D. that it sponsors. Is that an excuse or a reason that the private sector usually chooses not to take up such opportunities? You and I don't know because we haven't had enough experiments where Government gives up its proprietary position.

Mr. SHAMANSKY. I am concerned. You had great faith in the market. I am always told this magical thing called the market is going to do these things and you are saying the magical thing doesn't have any energy. It is not very effective.

Dr. GELLMAN. I think it is effective.

Mr. SHAMANSKY. It isn't effective here. Who is interfering with it?

Dr. GELLMAN. When the Government takes even nonexclusive rights to a technology, it is certainly limiting our system's working. We have a very great faith, generally speaking, in the patent system. While I don't know whether that faith is warranted or not, when we take away that sort of protection as a condition of granting an R. & D. contract, which is the usual case, perhaps we don't let our system work for us as it could.

By waiving nonexclusive royalty free use, by letting exclusivity lodge with the R. & D. performer, would that have the effect we would like to see? I don't know because we haven't conducted enough experiments across a broad enough front——

Mr. SHAMANSKY. Isn't it true that sometimes the Government is able to make an exclusive arrangement based on the willingnes to exploit it? There is such a possibility.

Dr. GELLMAN. Not much. There are some exceptions.

Mr. SHAMANSKY. There is a precedent that if someone wanted to market something, they could approach the Government and say I will do this if you do that.

Dr. GELLMAN. I have been involved in approaching the Government on those matters many, many times and never with complete success. The one that comes to mind where we did in fact achieve something, it took so long that the competitive edge was melted away. It took 2½ to 3 years, as I recall, to get the results you suggested.

Concluding as quickly as I can, I think we need to recognize also that the process of innovation is a very complex one consisting of myriad elements, and that there are many elements in the process of technological innovation that prevent our small enterprise community from providing for itself and for us all the economic growth, development and well being that they have the capability of providing.

In majy cases this is because there are certain elements of the process of innovation that are particularly difficult barriers for the small enterprise to climb over. For example, just one example, I suspect that there is an important role for Government to play, not so much as subsidizer but as provider for a fee of prototype and testing services in many fields of endeavor.

In analyses we have done on processes of innovation—specific outcomes and services, real innovations—we have found in many cases that prototyping and testing are two very important elements of the process of innovation that you must get over where the capital requirements and, indeed, some of the intellectual capital required is not practical or possible for a small enterprise to accumulate and exploit a sufficient percentage of the time.

I would think without anticompetitive effects, there are mechanisms that could be employed by the Government that would return to the Government any expenses it might incur while still encouraging quite dramatically small enterprise exploitation of what we call technological possibilities.

I am prepared to conclude at this point. I have many more things I could say over a much greater length of time but I will forbear.

Mr. **Shamansky**. Thank you, Dr. Gellman. Our next witness is Prof. Albert Shapero of the Ohio State University which I am proud to note is in Columbus, Ohio, my home. I have been a longstanding fan of Dr. Shapero. I am still thinking about all the issues he raised. It is a great pleasure for me to welcome you, Professor Shapero, to our committee.

Dr. **Shapero**. Thank you very much. This is a pleasant surprise to be in front of a fellow Columbusite.

In this testimony, I would like to contribute some data-based ideas somewhat at odds with what appears to be the congressional wisdom that states that American innovation and entrepreneurship have been declining or are in disarray primarily due to the lack of venture capital for one thing, as well as many other items that are brought to bear.

I would also like to suggest at the end of my prepared statement here some policy directions that I believe could significantly increase desirable new company formations and their subsequent survival and growth in both high technology and other technology areas.

First, let me make the following points: First, I think there is little convincing evidence of a decline of entrepreneurship or innovation in our country.

Second, there is no less venture capital available to innovative companies today than has been available historically. That's not very comforting but it's not very different.

Third, capital for company startups comes predominantly from personal and local sources, and is not a function of such highly publicized institutional sources as venture capital firms or the stock market, which occupies possibly 99 percent of the discussion in public media circles.

Fourth, perhaps the most critical gap for inventors and potential entrepreneurs is the money required to do those things, such as feasibility studies, testing and business plans, that will enable them to get capital from conventional sources. There is an inordinate interest in high technology which is more romantic than useful from the national viewpoint.

Over the past several years, the rate of new company formations has been steadily rising in good times, remaining at a very high level though flattening, in hard times, such as today, when interest rates and inflation are high. The indicators are strong though there are no valid statistics on the number of company formations or failures in the United States.

Estimates of startups by knowledgeable people range from a half million to 1 million startups a year. We do know that the IRS showed a net increase of over 2½ million businesses in the 10 years between 1965 and 1975 and that the number of businesses in the national inventory is increasing each year.

Taking various estimates of failure rate into account, it is easy to reach a number that fits within the previously stated range. Consequently, I conclude there is no dearth of entrepreneurship in the United States.

Incidentally, to underline something that Dr. Gellman said, the data are atrocious. The only data we have on failures are provided by Dun & Bradstreet and anybody who has been in business would hardly base an estimate on that.

The estimates are nonsense. Any way you look at it, you hear conventional stories that 90 percent of all new companies fail the first year and 65 percent fail the third year. These are all based on the same poor set of data. Even admitting, Dun & Bradstreet whimpered a little and said nobody was supposed to use them to estimate these kinds of things.

There is a body of literature based on the reasons for failure based on the same nonsensical data. All we do know is that IRS data, in that data, the number has increased significantly.

A side comment, those failure rate numbers broadly believed are one of the real deterrents to entrepreneurship because they are very convincing that everybody is going to fail before they start.

Furthermore, despite many attempts at showing a drop in innovation through such surrogate measures of patents, R. & D. dollars, degrees issued, number of publications, there is no direct evidence of a drop in innovation. Measures of innovations are hard to come by and especially of the many surrogate measures that have been used to make a point about innovation is easily refuted by other learned studies. There is a recent article just came out in Business Horizons that I think does a very good job of reviewing the literature on the subject. I recommend it to anyone who wants to look at it.

For example, a Business Week article stated as evidence of the drop in innovation the fact that in 1969 there were 204 new public licensed technology based companies and the number dropped significantly in subsequent years.

What they left out was the fact that there were a total of 548 small business public offerings in 1969 and that number dropped to 4 in 1975, because the whole stock market had gone into decline. It had nothing to do with the innovation, it was just the matter of public issues.

If you compare the 204 publicly financed new technical companies to the ½ million to 1 million new companies formed that year, you can see it is a trivial number.

Let's go to the subject of venture capital availability. Venture capital has never been available in any significant quantity for high-risk items, except in periods of fad or glamorization. If I were right—right now we have a new-found interest in biologicals. There are two ads in the last issue of Nature magazine which offers funding help for any biochemical ideas.

They are just saying, come to us in Switzerland and New York and offering funding because there is a new-found, heated-up market for biologicals and genetics.

If I called a company the Columbus Cheese Co., it couldn't get a hearing from anyone. But if I were to call it the Silicon Valley Mold Technology Co., which is cheesemaking, I could probably get 30-to-1 price earnings ratio in short order and get all kinds of people wanting to take me public.

Historically, new technologies have always found it tough. They are high risk and that makes new ventures have a hard time getting money anyway, but higher technology, which has higher risk, has a harder time.

Many of us have a perception that there were better days before because of the "go-go" years of the sixties stock market. Many of us would like it to return and lots of people are pushing for a return because they missed their chance the last time and we can still remember it.

However, if you look back into the way aircraft were financed and the way automobiles were financed, you found a fad fetish with the aircraft industry. The aircraft industry was hard put to get public moneys until 1927 after Lindbergh flew the channel.

There was a popular interest in aircraft and the stock market was heating up on its way to 1929. Then they got support.

Automobiles had a tougher time. They forced their dealers to finance them. They got up-front money from dealers so the automobile industry could get its financing. There has always been a hard time for new technology.

So today is not much different. How one removes the risk from it, except through Government guarantee, and I don't advocate that, because we will mask bad from good technologies. Today what is current, is a question.

The next point I would like to make and I think it's probably one of the more important points I can make, is that no venture support is essentially local.

Every study that's been made, and there aren't many, of how new ventures get their funds, new startups, shows that 99.9-something percent of all new ventures get their money from personal savings, personal borrowing, at the bank, family and friends, and what we used to call when I was at the University of Texas, good old boys, local people of wealth who invest in the business.

I would like to add the following: We did studies, and I think they must be among the only studies—I had some of my students working on a dissertation of how local people responded to new and different companies. We took investment situations to private investors to two cities in Texas.

They were in the same social cultural milieu, in the same economic region, in Austin and Waco. One city had grown, one city had not. One city had lost population. We found how local people would invest.

Interestingly, we found significant differences between the way people invest in the cities that grow versus the cities that didn't grow. What we found was that private individuals invest in a way that's rational, but not as described in the textbooks. They invested—the returns had to be above a certain threshold and they invested after they looked at the person and the deal and the subject matter of the company. They had to like both of them.

At first we thought this was personal and whimsical. Later on, we found they did better than most venture capital firms do. Incidentally, we were accused that it wasn't even America, it was only in Texas. I got a doctoral dissertation student and a French student and had him do it in France.

It was really obvious, because he cried all the way to France, insisting that there was no venture capital in France. I got him to go to France, which is as different from Texas as can be, and found the same kinds of responses. Except for moderate differences, because of local law, the same kinds of people responded in the same kinds of way to new ventures.

Another thing I must point out is that the venture capital firms under the best of construction do very few startups. Stan Pratt, who keeps track of these events, told me that there were 550 venture capital firms in the United States.

I know Diebold Associates made a study and found out that they made about three investments per year, of which less than 10 percent were for startups. That doesn't amount to very much in terms of new companies.

Again, we did other studies of loan offices because loan offices play an important role in the early stages of new companies or whether the entrepreneur will get the loan as interpreted by the loan officers in terms of the three Cs, one of which being character.

We took venture capital situations, many of them technical, young, new and different companies which are the essence of development, taking them to 200 loan officers in 40 banks in six States, and we found tremendous variation. Two loan officers sitting next to each other, one would make the loan and the other wouldn't.

Both would say it is the bank's loan policy. The vice president of the bank would say neither was the loan policy of the bank. We found differences between banks and differences between cities. I have been involved in a similar study in Columbus and it is as different from Texas as France. Mr. Shamansky can probably attest to that.

Mr. **Shamansky**. I can't even recognize what you're saying. [Laughter.]

Dr. **Shapero**. Again, at the local level, how the local financial community responds makes all the difference in whether a company gets started and nurtured in its most critical years. Most of the attention at the national level on the stock market and on venture capital firms, is interesting, but ho-hum from the viewpoint of entrepreneurship in general throughout the country.

Another point I would like to make is about where the money is most needed. I call it shovel money but I didn't invent it, though I wish I had. A very perceptive and astute Canadian venture capitalist, Burke Brown, in Toronto, has coined that term to describe the term "shovel money," to describe the moneys required to bring a new business notion to the point where it can be intelligently and properly responded to by potential sources of capital.

As he puts it, there is money lying in the street, but you need a shovel to pick it up and it's getting the shovel that's the hardest problem for the would-be entrepreneur or inventor. He needs support for those activities ordinarily done by staff people in large corporations, and not very well, incidentally. But they have the resources available and charge it to their overhead in terms of feasibility studies, testing, development of market research to get together the materials that will make a plausible argument that can be presented to sources of finance. We do have some very intelligent programs in the Federal Government and I must say surprisingly so.

In the National Science Foundation, you're going to hear from Mr. Roland Tibbetts, and he has an excellent program. There has been a program funded in the Department of Defense but fighting a bureaucratic battle because they gave him the authorization but took away his staff.

These are programs that have been financing the shovel money. They essentially bring the Government in at the proper point when the risks are very high and when the cost is very low. It is a cost for seed money for these early activities.

The program is so designed that when the risks are down by some feasibility have been demonstrated and the costs are going to go up, it is then geared to go into the private sector where those who will gain and profit by it can now put up the money.

So, we have some recognized efforts in this area, but in general, this is a very great lack. There have been attempts by some agencies to put centers in universities but not always having been a university person I'm not very sanguine about universities being able to find their derriere with both hands with regard to this activity. There is nothing in the university to prepare it to do this job.

I would like to make is a few policy suggestions. I think there is more to innovation than high technology. Rocks do not have spirits. Things do not have a life of their own. Technology has no meaning without people.

We heard before that the Japanese take much of our technology and exploit it successfully. I would like to suggest that this is an example of the romantic and primitive view of innovation. I have studied entrepreneurs for two decades and I am fascinated by them. I have seen several companies that started with a hot technological idea that didn't work, but they didn't go out of business. They are doing something else. They started with an aerospace contract and now they are making a ski binding. The entrepreneurial event is our real source of innovation. No other country in the world has the number of company formations, the relative number of companies formed, and the friendly environment to enterpreneurship in the popular culture outside the universities.

I would like to suggest that we are having our brains beaten in when it comes to glassware, shoes, production techniques, and that there is far more to be gained by the development of new methods of joining metal and cutting metal and new materials than there is in just such narrow construction of high technology as is popularly put forth.

I would like to make some policy suggestions, and I wish I could be more explicit but the data do not permit. We should consider how to expand and encourage local investment in new ventures and not concentrate so much on the national marketplace. The trouble with doing something in this area, however, is that we know very little about it. There is no interest in research in this area. For example, if you look at finance textbooks, there is usually a half sentence about private local investors discussed among other sources of venture capital. Therefore, it is hard put to say explicitly what should be done, except to say that we must look at how local people respond and find a way to encourage that investment. Invention does not only occur in Boston, the Silicon Valley, or Washington, D.C. We have a large and very dynamic country with invention and potential entrepreneurship throughout its length and breadth.

Some of the current attempts at policy are defeated when you look at them from the local level. In our study at Columbus a local investor went through our list of companies and their description and indicated what he'd invest in. We then asked him policy questions such as, "Sir, if you could roll over your investment, would it change your decisions?" His answer was very good, "Generally, yes; specifically, no." He liked the policy idea in general but when it came to a specific company the policy wouldn't change his mind one bit. He looks at the specific situation at the local level. Little is understood about this local response dynamic.

I suggest we have to do something to tune banking at the local level. Banking varies tremendously by city and by region, but the potential in just changing the perceptions of loan officers to where 1 percent of commercial money is shifted toward new and young companies has more potential in it than 10 times all the federal programs that have been funded in the last several years. Tuning of the existing system has more potential than all new programs that have to be proven and debugged combined.

We need "shovel" moneys. We have to design programs that are not as restricted as the one in the National Science Foundation, which is restricted to very high technology. I suggest that we encourage the proliferation of such programs not only through Federal programs, but out to the States and out to communities using a much broader construct of technology than is now applied by NSF. I think this could have tremendous effect and also stops this regional disproportionate attention on two or three areas of the country.

Finally, just again, whatever programs we have to broaden should broaden the nature of what we call technology. Thank you.

[The prepared statement of Dr. Shapero follows:]

SMALL BUSINESS, INDEPENDENT INVENTORS AND EARLY FINANCING FOR NEW TECHNOLOGY

by

Albert Shapero, Professor
Ohio State University

In this testimony I would like to contribute some data-based ideas somewhat at odds with what appears to be the conventional wisdom that American innovation and entrepreneurship have been declining in recent years primarily due to a lack of venture capital. I would also like to suggest some policy directions that I believe can significantly increase desirable new company formations and their subsequent survival and growth.

First let me make the following points:

1. There is little convincing evidence of a decline in entrepreneurship or innovation in our country.
2. There is no less venture capital available to innovative companies today than has been available historically.
3. Capital for company startups comes predominantly from personal and local sources and is not a function of such highly publicized institutional sources as venture capital firms or the stock market.
4. Perhaps the most critical capital gap for inventors and potential entrepreneurs is the money required to do those things (feasibility studies, testing, business plans) that will enable them to get capital from conventional sources.
5. There is an inordinate interest in "high" technology which is more romantic than useful from the national viewpoint.

Entrepreneurship and Innovation

Over the past several years the rate of new company formations has been steadily rising in good times and remaining at a very high level in hard times. The indicators are strong though there are no valid statistics on the number of company formations or failures in the United States.[1] Estimates of startups by knowledgeable people range from 500,000 to one million startups per year. We do know that the IRS showed a net increase of 2,563,000 businesses in the ten years between 1965 and 1975 and that the number of businesses in the national inventory is increasing each year. Taking various estimates of failure rate into account, it is easy to reach a number that fits within the previously stated range. Consequently, it must be concluded that there is no dearth of entrepreneurship in the United States.

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[1] Shapero, A., "Numbers that Lie," INC, May 1981 (See attached).

Furthermore, despite many attempts at showing a drop in innovation through such surrogate measures as patents, R&D dollars, new issues of technological companies, degrees issued, or numbers of publications, there is no direct evidence of a drop in innovation. Measures of innovation are harder to come by, each of the many surrogate measures that have been used to make some point about innovation is easily refuted.[2] To take one example, a Business Week article stated as evidence of the drop in innovation the fact that in 1969 there were 204 new publicly financed technology based companies and that the number dropped significantly in subsequent years. What wasn't pointed out was that there were a total of 548 small business public offerings of all kinds in 1969 and that number dropped to four in 1975; the whole market for new issues, including new technology companies, had gone into decline.

Venture Capital Availability

At the present time, companies with a high technology flavor are in demand among venture capitalists to the point of irrationality. If a company called the Columbus Cheese Company were to try to obtain venture capital it would be completely ignored. However, if the same company were to change its name to the Silicon Valley Mold Technology Company, it could command a premium from any number of high technology oriented venture capital companies. After all, it's in the new and exciting field of biologicals.

Historically, new technologies have had a hard time in the capital marketplace. New companies have always had difficulties obtaining capital, and the higher risks associated with new technologies makes the task even harder. Many of us have had our perception of the problem distorted by the highly atypical "go-go" stock market of the 1960's, and some of us are nostalgic for those days.

The aircraft industry had a hard time getting stock market support until 1927 when Lindbergh captured the popular interest with his flight across the Atlantic and the market was heating up on its way to 1929. The automobile industry had difficulty getting venture capital and resorted to getting its capital from its dealers by requiring up-front money.

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[2] Crawford, C. M. and G. J. Tellis, "The Technological Innovation Controversy", Business Horizons, July August 1981.

New Venture Support Is Essentially Local

New venture support is predominantly personal and almost overwhelmingly local. With the exception of a few highly publicized companies, such as those involved in genetic technology, the capital required for startups comes from the personal savings and borrowings of the entrepreneurs, family, personal friends, and local investors such as professionals and businessmen in the community. This has been found to be true in all countries and in every area of the United States. Regions differ in terms of the responsiveness of their local financial communities. Some are highly responsive, some are unresponsive, and if there is to be response at all it is local. Similarly, studies of loan officer response have shown that there are great variations between individuals, banks, and communities, with some communities showing far greater willingness and ability to respond to new and different companies which are the essence of development.

Only an infinitesimial percentage of startup financing comes from the formal venture capital institutions. It is estimated that the 550+ venture capital firms made on the average something under three investments a year of which less than 15% were for startups. Mr. Stan Pratt, who keeps track of such things, tells me that the average number of investments per year has gone up to six or seven recently with a new found emphasis on high-technology and a somewhat higher interest in startups.

"Shovel Money"

A very perceptive and astute Canadian venture capitalist, Burke Brown, has coined the term "shovel money" to describe the monies required to bring a new business notion to the point where it can be intelligently and properly responded to by potential sources of capital. As he puts it, "There is money lying in the streets, but you need the shovel with which to pick it up." Perhaps the most pressing need of the inventor and potential entrepreneur is for shovel money. He needs support for the activities that will enable him to do the testing, feasibility studies, market studies, business plan preparation that will enable his idea to receive an adequate hearing in the financial marketplace. Big companies have staffs to accomplish all the foregoing activities within the resources of ongoing company operations, a capability not available to the inventor or nascent businessman. Among the most intelligent programs the federal government has fielded in regard to "shovel monies" have been those of the National Science Foundation, and, more recently, the Department of Defense. The foregoing have tried to fill the gap through grants to technical entrepreneurs for shovel money activities. The programs have been beautifully designed to bring the government in at the proper point when the risk is too high for private venture and the cost is lowest. Furthermore, the programs require private industry commitment and support when the risks have been lowered and investment requirements go up . This government seeds the technology for the good of society when the risks are very high, and private interest bears the investment brunt when profits can be seen.

There Is More to Innovation than High Technology

"Is the only useful form of entrepreneurship that associated with high technology? This is a question that keeps coming up during this meeting because we have a great involvement with the romance of technology. If we can only get high technology as opposed to low; we all know "high" is good, "low" is bad. Somehow if we invented technology higher than somebody else's, and get more patents we will laugh all the way to the bank -- like the Japanese? Our romantic attachment is a primitive view of innovation. It assumes that rocks have spirits, that each innovation has some intrinsic spirit of its own, independent of society and people's needs and how they manipulate the innovation. This viewpoint is mistaken. I would suggest that the innovation in entrepreneurship is the event itself. Every entrepreneurial event is an innovation which may or may not bear new technology. The new business may incorporate a new way to treat customers well. The event is the innovation, and we should not get hung up on what it sells. There are many examples of technical entrepreneurs who left employment with one company to build particular gadgets that they loved, and guess what? They are making different gadgets now they didn't think of at first. When their dream gadget fails they do not quit. The point is that entrepreneurs create something in society despite which gadget they are making and selling. We must not get hung up on the gadget."[3]

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[3] Shapero, A., "The Entrepreneur, The Small Firm and Possible Policies," *Six Countries Programme Limerick Workshop*, 1980.

Small firms undoubtedly have a key role to play in bringing innovative high technology products to the market. Such firms are significant sources of new employment and they maintain the health of the economy by providing both competition and sources of new products or processes for large firms. Nevertheless, high technology firms are but the tip of the iceberg of the total small industry sector. 16,000 new industrial firms are annually founded in the Federal Republic of Germany, of which approximately 800 are regarded as innovative in the narrower and 3,500 in the wider sense of the term.[4]

> "We categorized firms according to their techno-economic environment. The first category was new firms in traditional industries, for example, medical supplies and instruments, mechanical engineering and offshore engineering. The second category was new firms in fast-changing industries, for example electronic measurement and control equipment and electro-medical instruments. The third category was new firms in a wholly new industry, namely 'system houses', which produce software in combination with hardware for applications in process control. The reason for looking for new firms in such diverse environments was our belief that there has been too much generalizations from research on firms in glamour industries. This leads to two possible dangers in our thinking about new firms. First that new firms are only important in technologically fast-moving industries - our categories two and three - because that is where they have been easiest to find. But we believe that the economic effects of new, technically innovative firms may be as great or greater in the larger areas of traditional industry. The second danger is that by neglecting new firms in non-glamours industries, policies designed to stimulate entrepreneurship will be one-sided and might be inappropriate for the great majority of potential entrepreneurs."[5]

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[4] Niederwemmer, U., "Management Support of Innovative Company Founders," Six Countries Programme, Limerick Workshop 1980.

[5] Prakke, F., "New Technology Based Dirms in the Netherlands," Six Countries Programme, Limerick Workshop, 1980.

Mr. **Gore**. Thank you very much. Mr. Shamansky?

Mr. **Shamansky**. Thank you, Mr. Chairman.

I want to say, Professor Shapero, I very much responded to your idea about the changing of the name. Everything I have noted lately is ending with tron, as in spectron.

Dr. **Shapero**. I think if you could call it biological genetic DNAtron, you would have it.

Mr. **Shamansky**. The ultimate would be the trontron. [Laughter.]

Dr. **Shapero**. You have to make it biological today.

Mr. **Shamansky**. The business of taking something up, alluding back to what Dr. Gellman referred to, the question of going beyond R. & D. or the Japanese using our technology, whereas American marketing genius failed.

Dr. **Shapero**. I don't know if American marketing genuis has failed.

Mr. **Shamansky**. Did it ever exist?

Dr. **Shapero**. If I had to pick a culprit, though I don't think there are culprits but a general cultural problem, I would lay the onus on the universities.

Probably the most massive program in the history of the world took place after World War II and it has never been studied. It was the Marshall plan. We set up productivity institutes throughout the world including Japan and transferred what was then known as American know-how, how to produce and sell things, to the whole world. We took techniques that were well known in the universities and engineering schools, from industrial engineering, and distributed them throughout the world. Then, we carefully excised this capability from the universities.

After World War II we got fascinated with research and development and we poured unrestricted research and development funds into universities. The engineering schools became haphazard physics schools. Business schools became concerned with model building and mathematical formulation. We threw away mundane things such as plant layout, quality control, the systems for which whole teams go to Japan to rediscover what was done in every plant in America in World War II. These were considered American methods then.

I spent a year in the International Institute in Italy and they told me that they were embarrassed—and I was embarrassed by their embarrassment—when they decided to invite American officials to speak to the convention of the European productivity institutes we had set up and it was as if the Americans had lost their memory of what we had taught them. They said they would never invite them again.

Mr. **Shamansky**. That still bothers me in the sense that we point to the universities. But where are the business people?

What I am trying to get at is: Why is it that we have to look to a Japanese company to fill a particular product, provide a particular product, when the need of the product or the market for the product should fairly well be apparent?

Dr. **Shapero**. I suppose I am giving you a prejudiced——

Mr. **Shamansky**. None of us here have prejudices. [Laughter.]

Dr. **SHAPERO**. I think that first of all many of the people who inhabit and populate our major firms are products of our university system. Most are products of the university of the last few years.

Mr. **SHAMANSKY**. Are you suggesting that the university imprint is stronger than the market force?

Dr. **SHAPERO**. I think the university imprint is important in the sense that it determines how people perceive and operate in markets. I shouldn't put it this strongly except that you asked about business schools before. I don't think we have any business schools in America. We have academies of corporate middle management. Small business is invisible in the university. It is taught by outsiders or by an occasional interested professor.

Mr. **SHAMANSKY**. Dr. Gellman, you had a comment?

Dr. **GELLMAN**. I think it is certainly true that the so-called business schools have short-shrifted small enterprise which is not only tragic but surprising in a way because I think there are in the university community those who do appreciate what small enterprise has meant to the development of this country both in terms of economics and technological change.

There just are found in universities too few people who have enough knowledge and appreciation and understanding of the area to feel confident enough that they can get up and offer this kind of insight and instruction to students. I think we need to do something about it.

It is going to take some explicit action. I would hope it would be a combined effort of the public and private sectors.

The other point concerns the example between the United States and Japan. If there is a cloud on the Japanese horizon, I haven't yet found it visible. But if there is one lurking below the horizon, perhaps, it may be that they are getting into areas where small enterprise is much more efficient than large in a technological exploitation sense, and their system largely denies themselves the best of small firm entrepreneurship.

They are organized to exploit large-scale activities. But it is in the large-scale area where we also have a problem. Just to give you one example, there is the microelectronics area and I don't think we ought to make any mistake about it. One of the threats to the U.S. microelectronics position, which is now both one of preeminence and predominance. One of the interesting reasons for the Japanese to be such a threat to us there relates to their having now aggregated under single managerial control an amount of capital for R. & D. on a regular basis that exceeds what we have seen fit to aggregate on a given level under single control for the same purposes.

What does this suggest? One of the things is that, for our general well-being, but also for the well-being of the small enterprise that is high technology oriented, we had better rethink our application of antitrust policies and laws.

We have got to redefine markets in this country where in fact the market is not a national one but a global one, or something broader than a national market, so that we see joint ventures and other forms of cooperation as supporting competition in the ultimate market.

We have got to force—I don't know how you do this exactly—but we have got to force those who are in charge of the development of antitrust policy and actions, we have got to make sure they have a broader and more forward looking view of antitrust and of the way the world is than they have displayed in the recent past and presently.

Mr. **Shamansky**. If I may, Dr. Shapero, the question of shovel money, that whole idea, is there any reason, taking Columbus, that the Huntington Bank Shares, Inc., which is the holding company, not the bank itself, which is Huntington National Bank, is there any reason you see any role for a bank holding company to provide—would it have the capital in your opinion?

Have you given some thought to this? Who might provide shovel money other than individuals?

Dr. **Shapero**. One person who has done a great deal of thinking on this is a venture capitalist, Mr. Burke Brown in Toronto, who has put together a venture capital firm to provide shovel money. Any institution can do that, but it is not within the usual activities of institutions. It has never been included in the functional areas that banks or holding companies have considered their responsibility.

As a matter of fact, the shovel money is required to put a situation into a format that banks and venture capital people in their normal practice can examine. Really what shovel money provides is the opportunity to not be turned down for the wrong reasons. I don't think a bank can do both, prepare and examine a situation objectively.

Mr. **Shamansky**. Who could do it in our society?

Dr. **Shapero**. Many consulting firms do this. I am not a great advocate of consulting, but consulting firms do this kind of thing. Professors are sometimes called upon by private individuals to do this. I do this through my classes. I go to the Inventors Council of Columbus and say put your effort where your mouth is. I will have my students develop a market or business plan. Thus, I will carry them past the first stage. I think a whole array of mechanisms could be developed for this purpose. It can be also done through existing institutions, by widening how the institutions perceive their present task.

I am critical of universities that set up separate institutes or centers to provide the shovel function. Though I admire many of the university people you are going to hear from and think they do good work, I also think bureau centers and institutes are not part of the university per se because the universities of the professorates of teaching and of research are not in the centers. The centers could be across town and run by someone else.

Mr. **Gore**. Speaking of the people we have yet to hear from, we are going to have to move on.

I would like to recognize Mr. Walker.

Mr. **Walker**. Dr. Gellman, you testified that small firms tend to be more innovative and get their products to market. Do you attribute that primarily to the fact of the entrepreneurship of the small inventor, his ability to kind of work things on his own, or is it partly institutional on the part of bigger businesses, the bureaucracies they have to go through?

Even if they come up with an idea, chances are the idea will get caught up in the bureaucracy. If somebody invented a revolutionary new automobile engine, it would have a hard time clearing the management structure in GM because of the investment they already have sunk in the internal combustion engine.

Dr. GELLMAN. I think all of the above in a sense. You are right about the inertia. It is not only general inertia but intellectual inertia most especially. I continue to believe that one of the reasons a smaller enterprise is more efficient is because the small enterprise has got its back to the sea more often than does the large.

It doesn't have a cushion. In our free enterprise system that is supposed to have the effect, and in fact does have the effect, of making the small entrepreneuer more attentive, more dedicated to success because the opposite is disastrous for them.

I think this is a critical difference. Indeed, it is one of the reasons why it is so important for large enterprise that small enterprise remains viable and a way of life for people to pursue in this country. There is a very substantial community of interest between the small and large enterprize portions of our private sector. I don't quite understand frankly why the large enterprise has so seldom recognized this and done something about it.

There is one very important point that Al Shapero made about differences regionally and locally that I think needs to be underscored in a little different way. The regional differences in this country are very important because the country is evolving, it always has and presumably always will. And this means shifts in emphasis regionally.

I think we darn well better understand and track the regional propensities to accept innovation and to be a hospitable place for small enterprise innovators to operate.

For example, if any of you want to read something that will shake you up on this, read the book entitled "Puritan Boston and Quaker Philadelphia." There is a vast difference documented in economic performance and a lot of other kinds of performance including innovative performance.

There are differences stemming from the early days of this country right down basically to the present. You will see that this country really needs to understand what the effect on innovation performance and propensity is going to be as the centers of economic activity change in this country.

They are changing and they are going to change forever. We ought to anticipate those changes particularly where the centers of economic activity shift in the direction of communities where you can forecast there is less efficient innovative performance to be expected.

The report that we earlier referred to, the study done for the Department of Commerce by a panel in 1967, pointed out that there are very great differences city to city in the propensity to generate new technology-based companies.

We ought to take this into account for all the reasons that Al suggested but for this other reason as well.

By the way, the SBIC's were supposed to provide shovel money. I think they have been an abysmal failure in that regard. Nobody seems to want to go back and look at the failure and understand why it failed.

I think we could learn a lot from our failures. Maybe we ought to have a moratorium while we go back and study failures in earlier attempts to stimulate small enterprise activities in this country, then we can start over and do it better.

Mr. **Walker**. I was going to pose a question to you here quickly. If you want to follow up on that point, fine. You mentioned the problem that you thought had been created by universities, had contributed to the problem I think is a better way of putting it.

There is one other aspect I would appreciate your commenting on and that is the extent to which the universities have impacted adversely on the ability of small, scientifically oriented laboratories to survive in the commercial marketplace by coming into Congress for tax advantages and a variety of other things which tend to skew the money toward universities rather than toward small business.

Have you ever taken a look at that problem? I have a couple of laboratories in my district that have been pointing out for years that they are taxpayers, that they have to operate on that same margin, Dr. Gellman, that you just referred to as taxpayers, and yet are in competition in particularly the R. & D. areas with university laboratories that don't have any of those obligations.

I would appreciate some comments.

Dr. **Shapero**. I know of no studies, but I know of great complaints. When I worked at Stanford Research Institute I used to be one of the complainers because in those days, some of the universities charged no overhead when we charged 100 percent. We considered universities as socialist competition.

Dr. **Gellman**. I happen to feel that is not a particularly serious problem and one of the reasons is that most of the firms that complain, the legitimacy of their complaint is somewhat undermined in my view by the fact that most of them have not got a dedication to do much beyond an R. & D. result.

As I suggested, they produce for the economy only the sound of one hand clapping because they don't have a commitment to go forward with the R. & D. to the marketplace. I think a far more dangerous kind of thing is where you introduce through Government purchasing power the likes of a Mitre Corp. and their ilk.

They never stand a marketing test, which means working in the private sector. You can never be sure you are getting your money's worth. You can't even be sure of that, of course, even if they stand a market test in the private sector. But the chances will be better.

Dr. **Shapero**. I wanted to make two points as to why smaller companies get at the marketplace faster and better with new technology. One of the top people of a major R. & D. division of a major consumer product corporation told me they would not consider a new product unless they could see 4 million cases of sales. The large number is because we live on a continent called the United States. To a French company or an Israeli company a million cases or even 100,000 cases would be a marvelous market. Small companies respond more quickly to the marketplace with less restriction.

We studied wholly owned corporations, and we found that a new, wholly owned subsidiary goes into the black faster with a new product than is experienced with the same product in an old division. You just don't have the social and political overhead, and the inertia that goes with it. New ventures just have that much more freedom to move than older ones.

Mr. **Gore**. I will forego my questions in the interest of time and invite our special panelists to direct questions to this first panel of presenters.

I would like to ask them to bear in mind that we have three other panels addressing specific aspects of this subject later today. I invite you to address concerns that you have for this general overview panel at this time. I would like to welcome Dr. Gilbert Levin. If you wish to join your colleagues here at the table. Mr. Kloss?

Mr. **Kloss**. Thank you. Back to the beginning when you mentioned the relative effectiveness of small companies with respect to return, rate of return, social versus private, can you expand a bit on what was meant by a successful activity in private return versus a social return?

Is it nature of products, number of jobs versus profit?

Dr. **Mansfield**. It was measured in terms of rate of return on investment.

Mr. **Kloss**. That is the private return. But the social return?

Dr. **Mansfield**. It is the same. In other words, if society invests $1 million, this may be a good deal more than what the particular innovator invests. But if the total investment is $1 million, and if society gets back a return of $50,000 per year, the social rate of return would be $50,000 divided by the $1 million, or 5 percent. On the other hand, if society gets back a return of $100,000 per year, the social rate of return would be 10 percent.

Presumably what you want is to invest in those activities with high social rates of return. So a 50-percent rate of return is an astonishingly high rate of return on the average for what might be called relatively trivial innovations.

I agree with Al as to the importance of low technology innovations. This is something that in a sense we have been preaching for a while. For example, there was a new type of thread. The social rate of return as I recall was something like 300 percent.

Mr. **Kloss**. What is the currency in which the social rate of return is measured?

Dr. **Mansfield**. The same as private. If you buy treasury bills, you get a certain percentage rate of return. Similarly, society receives a certain percentage rate of return from the investment made to bring about a particular innovation.

Mr. **Gore**. I think what he is getting at is would you measure it in—you measure it in dollars, but how is it made manifest? In tax revenues as a result of sales generated? Isn't that what you are getting at, Mr. Kloss? How do you actually——

Mr. **Kloss**. What was meant by social rate of return.

Mr. **Gore**. Yes. Where do you see the social rate of return?

Dr. **Mansfield**. Let's take the case of this thread. You had a thread which was improved so that sewing machines could run faster so it was possible to reduce the cost of producing clothing.

There were in effect increases in efficiency throughout the economy.

Mr. **Kloss**. More and better jobs?

Dr. **Mansfield**. No, not just jobs. There was a reduction in the total resources used: Capital, materials, labor, and so on, all of which are inputs. You reduce the cost involved in producing a certain amount of apparel. You can produce more apparel. Add up the increase in the apparel produced plus the reduction in the resources used per year. This is a rough approximation to the annual social benefit.

Divide it by the total investment in the development and introduction of this new thread. You come out with a rate of return of about 300 percent. To economists, this is like mother's milk; the concept of a rate of return is used all the time.

Mr. **Kloss**. Thank you.

Mr. **Gore**. Dr. Ramey?

Dr. **Ramey**. Again to Dr. Mansfield. Today we produce more technology than any other country on Earth. But we lag in inventions, perhaps not in innovation, though. Critically we seem to eventually import the products of the technology we produce.

Should we create more science or should we again learn how to promote the use of technology through innovation and invention? Should, say, business startup be an active research area?

Should we have more programs such as that managed by Mr. Tibbets at NSF?

Dr. **Mansfield**. I am just writing it down.

Dr. **Ramey**. It is one question.

Dr. **Mansfield**. A little while ago I gave a talk. There was a person there who strung together about 50 questions.

Dr. **Ramey**. What should we be doing now is what I am asking.

Dr. **Mansfield**. All right. Let me try to address it. First, there is another sort of concept which is very important in economics known as comparative advantage. I am sure that we are all familiar with it. It does operate to determine what it is that makes sense for us to do and what it is that it makes sense for other countries to do.

Now it is quite possible that in some areas we do have a comparative advantage in the science end, the development end, but not necessarily in the production end.

You see some of this with the joint ventures that have occurred between American firms and those in other countries. And also, in the spread of the multinational firms which do the bulk of their R. & D. in the United States and a considerable amount of their production and assembly overseas. I think you have to look at this in terms of its being in our interest and also in the world's interest to have some specialization of this sort, at least at present.

I am not sure it is a good idea necessarily to put R. & D. money, supported through the Federal Government or supported otherwise, in industries that are declining just because they are declining. You want to look at how large the payoffs are not necessarily whether the industry is in trouble. Unfortunately, that, sometimes has been part of our policy the past as far as R. & D. is concerned.

Turning to the next part of your question, should we do more to increase our capabilities so far as innovation is concerned as distinct from science? Absolutely. In the past, if you look at the broad history of this, you find that the United States was not very eminent in science a hundred years ago. But we were an absolutely first rate power with respect to technology, invention, innovation. These were the things we were good at.

As a consequence really of World War II and Hitler's activities and related matters, we attracted a large number of first rate scientists. We put far more money into science and so on. At this point we are in excellent shape as far as science is concerned. But it is conceivable that we could go the route of the British who after all have been very good in science. You look at the ordinary measures of scientific proficiency and you will find that Britain does quite well.

The problem in Britain, and they recognize this and have recognized it for years, is innovation and the application of science. They have been first in terms of the science very often. But other countries often have gained the profits.

I think it is very important that we maintain and strengthen our innovative capabilities. To a large extent, it is not a matter of adding entirely new weapons to the American arsenal in this area. Generally, it is instead a matter in part of getting out weapons that we used before extremely well and also being sure that those weapons that we still use very well don't get rusty. There is no question but what there has to be an emphasis on this part of the process, as well as on science.

I don't know whether that is responsive to your question or not.

Dr. RAMEY. It is directly responsive.

Mr. GORE. Dr. Levin?

Dr. LEVIN. Thank you, Mr. Chairman. First I would like to ask a question of the chairman. Is there some design in the fact that you have selected the examples of small high technology firm experts and independent inventors to ask the questions rather than to answer them?

[Laughter.]

Mr. GORE. We are glad—yes, there is a design or in the cliche, method to our madness. If you have answers, we are glad to have those, too.

Dr. LEVIN. It may well be that your recognize that the small, independent inventor doesn't really know the answers, even sometimes as to why he is doing something, so it may be appropriate.

I would like to ask Dr. Shapero if he could define for me his interpretation of "high technology." That seems to play some kind of a key role here. Should we be proposing more high technology or low technology? Perhaps that awful new term appropriate technology?

Dr. SHAPERO. I put high technology in quotes to show that I think it is a silly term. There is one definition that the Dutch use. The Dutch categorize firms according to their technoeconomic environment. The first category was new firms in traditional industries, for example, medical supplies and instruments, mechanical engineering and offshore engineering. The second category was new firms and in fast-changing industries, for example electronic measurement and control equipment and electromedical instruments. The third category was new firms in a wholly new industry, namely system houses which produce software in combination with hardware for applications in process control.

The Dutch pointed out that they believe that for example, the first two categories would be more traditional and the third would be high technology; new industry, new field. I put "high" technology almost pejoratively because it usually has referred to something that people have accepted as high technology.

Another definition that I have used for my own purposes is it depends on the amount of scientific labor required in the end product. When semiconductors were turned out by Ph. D.'s in physics in batches in the laboratory, I would consider that high technology. But now it is in the instrumentation and it is turned out by people with no education. Then it is moved from high technology to another area.

Dr. **Mansfield.** Often when people talk about high technology, they really seem to mean R. & D. intensive areas.

Dr. **Levin.** My followup question to Dr. Shapero, you have indicated that the statistics of the various studies showing decline in our innovation, et cetera, are not very reliable. You have made some general statements, really, to the other effect: That you don't believe our innovation is declining. How do you support those statements? The statistics are equally lacking, I presume.

Dr. **Shapero.** Which makes mine equally valid. [Laughter.]

I would suggest that perhaps mine is not based on statistics, but more observation. I still find Popular Science exciting every month. It is full of notions and inventions. I find Heloise interesting for the amount of innovation that is found there. I find when I can stir students out of their analytical frames of reference, that I get a good deal of innovation.

Most measures used are surrogate measures. They either talk about research and development expenditures, degrees produced, articles produced. These don't come to grips with innovation. Genetically, we have no less creativity or invention today than before. We may have problems in marketing. We may have problems as we have been suggesting, I think all three of us here, in translating at the earliest stage from notion into the marketplace. But in terms of invention, let's say, new ideas, the idea production rate, there is no evidence that it is going down.

Dr. **Gellman.** I think there is another point to be made here. The demand for science in a sense should be viewed as a derived demand; that is, it is derived from what people want to make of science in various markets. I think that if there were no other reasons to support improved technology delivery with public funds, it would be enough that more efficient, timely technology delivery clearly stimulates scientific development.

If we don't have the conditions under which innovation returns very high amounts of glory and money to entrepreneurs, science in the reservoir will dry up. I think the two are inextricably linked. I know that World War II pushed us into the position of general science preeminence we have enjoyed until now; the two are linked. I think there is a derived aspect of the need for science.

With regard to high or low technology, there is a problem with definition. Why do we classify it in the first place? One of the reasons we classified one as high and one as low is to have a nice handy way to distinguish what seem to be both logical and fundamental differences. But look what we did. Officially, the Department of Commerce declared the automobile industry a high-technology industry and that led to very bad results, whereas, agriculture was defined as low technology and led to some not-so-bad results because we kept our hands off it in certain respects. Why did they do that? Because people saw agriculture not in the context of the market in which agricultural products are produced and sold, where the United States was and is the highest technology country there is, but in terms of some really naive and juvenile notion of what technology really means.

Technology really means very little for public policy unless it is viewed in terms of the market in which that technology is exploited. I think that is a very important point that people in the Congress and in the administration of this country ought to recognize. Still there is a reservoir of scientific results that need to be maintained reasonably full in order to provide the raw materials which provide jobs and redistribute income in favorable ways. We have got to have a balance in support of science, in support of technology delivery systems development.

Dr. MANSFIELD. If I may, let me take 1 minute.

Mr. GORE. Yes, briefly.

Dr. MANSFIELD. I agree entirely with the last point, of course. I would like to go back to the question that was initially posed. I think that you have to distinguish between a number of different areas within the economy. I agree that good evidence is lacking. We have very poor measures. No question about that. But nonetheless, I think that one kind of measure hasn't been mentioned. It has been mentioned that one can talk with a variety of types of people, but it is also a good idea to talk with leaders in science and technology in these industries.

I thought that that was one reason why some people were invited to these hearings. I think based on a good many such sessions and a good many such conferences that if you look at industries like drugs and agricultural chemicals, that there is a reasonably general feeling that there may have been a slowdown in innovation and that there are some fairly well-defined reasons for it.

But, if you look at microelectronics, I don't know that there has been any slowdown. Because of the differences among sectors in this regard, there are serious problems in trying to aggregate. I think it is not too meaningful, perhaps, to talk about changes in the rate of innovation in the economy as a whole. I think there are some areas where there is a fair amount of evidence of a slowdown, and other areas where there is not. If you are concerned about a slowdown, you ought to look at those particular areas.

Mr. GORE. Thank you very much. We are going to have to move on. This is a very interesting discussion. I appreciate our first panel getting us off to such a good start. I think it is clear that we could continue to ask questions and explore the knowledge that this panel has. We appreciate your appearance here today.

Our next panel will give us an overview of the contributions of large corporations. We have Walter J. Cairns and Sherman Abrahamson. We welcome you gentlemen. Without objection, the entire text of your prepared statements will be put into the record.

STATEMENTS OF WALTER J. CAIRNS, VICE PRESIDENT, ARTHUR D. LITTLE, INC.; AND SHERMAN ABRAHAMSON, SPECIAL ASSISTANT TO THE CHIEF EXECUTIVE OFFICER, CONTROL DATA CORP.

Mr. CAIRNS. I would like to thank you for the opportunity to participate in this exchange of views on the role of small high-technology firms and independent inventors in technological innovation. It is a subject of intense interest to my company and to me. It is also an area in which we lay some claim to competence.

Arthur D. Little, Inc., whose invention management and equity venture activities I direct, is an international research, engineering, and management consulting organization. We have, since 1886, been among the pioneers in adapting and developing emerging technologies to meet the needs of industry and society throughout the world. In recent decades our professional staff has been deeply involved not only in technological innovation but in managing the increasingly complex interaction between technology, the economy, and society.

The invention management program, which I helped to found nearly a quarter of a century ago, was and is a logical extension of our consulting work. While my responsibilities as manager of Arthur D. Little Enterprises now include venture capital and other speculative activities, the invention management program remains the flywheel behind all Enterprises activities.

If I have learned anything in the past 25 years it is to challenge some basic shibboleths about inventions. The myth of the better mousetrap, for example.

We have managed inventions, whose propects appeared golden, which come to nought because of a variety of unforeseeable events. Our experience has been that fewer than 50 percent of the inventions which pass our rigorous screening and in which we invest time and funds on development ever pay back their investment and only 10 to 20 percent of those will show a large profit. I might point out that on average only 2.5 percent of the inventions presented to us pass our initial screening. We look at approximately 600 disclosures a year.

When an invention has been selected for management, a project funded by Arthur D. Little Enterprises is opened. We select the project manager and establish project objectives, budget and schedule. The scope of the project frequently includes further technical development work, studies relating to markets and manufacturing costs, patent work, including filing U.S. and foreign patent applications, and the selection of the most appropriate licensing strategy.

If I were intimidated by the long odds, I would not be in the invention management field. But I think it is important to recognize that the commercialization of invention is a very high-risk business. The potential return on a big winner can, of course, be enormous, but we must be prepared for a lot of disappointments along the way.

The other thing is that the smaller entrepreneurial companies are the most apt to bring their own new inventions to the market. It has to be recognized that the free activity of an inventor and the skills of an entrepreneur or business manager are quite different. I should point out that Henry Kloss, who is on the other panel here, is a man we have known for many years. I think he represents a departure from that statement. He is the unique combination of the innovator and the successful entrepreneur. There aren't many.

It should also be recognized that while innovative capability appears to be in inverse ratio to company size, the managerial capability most often is a function of company size. Few inventions provide the basis for a successful startup or for the rapid expansion of a small company, even if adequate capital is available. Moreover, a number of innovations, particularly in some high-technology areas, require the kinds of resources which only a large company can provide for testing, production development, marketing, distribution, and overall product management.

We have learned from our invention management experience that considerable high-risk investment is required to advance a new invention to a licensable state. Our average project today requires an investment in the $30,000 to $50,000 range, but a few projects will cost several hundred thousand dollars and will extend over several years.

Owners of small high-technology companies with inventions they are unable or unwilling to bring to market rarely can afford to risk investing in the development of the invention with the sole purpose of licensing it to others. The odds against any single invention paying off are simply too great. Furthermore, I know of no private or public sources of funds for such high-risk investment. Means should be developed to provide significant benefits to small companies to enable them to invest in developing the promising inventions they cannot commercialize to the point where they become licensable.

Simply, it may be productive to encourage manufacturers to overcome their traditional barriers to accepting new inventions from outside sources. An obvious incentive would be preferred tax treatment of payments made to individuals and small companies under license agreements. Arthur D. Little Enterprises is one of less than a handful of companies which will manage inventions without charging a fee to the inventor with the intention of investing our own funds and staff talent in further development of those inventions. We are one of the even fewer companies which has managed to make a profitable business of invention management. Our affiliation with the problem-solving research-oriented area like Arthur D. Little, Inc., is no small factor in our success. However, even our experience, a best case example, illustrates the need for tax incentives for inventors, for financial backers and for licensees to promote innovation and the practical application of innovation.

We stay in the business in part because we are incurable optimists and in larger part because the company and as individuals we are committed to promoting innovation. We believe high technology and the capacity to innovate are among our Nation's most important assets. We also believe many more high-technology inventions which could benefit our economy and the society as a whole would reach the market if tax incentives were instituted to ease some of the financial barriers to innovation.

Thank you for your attention.

[The prepared statement of Mr. Cairns follows:]

PREPARED STATEMENT OF WALTER J. CAIRNS, VICE PRESIDENT, ARTHUR D. LITTLE, INC., AND MANAGER, ARTHUR D. LITTLE ENTERPRISES

Mr. Chairman, members of the committee, ladies and gentleman, Thank you for the opportunity to participate in this exchange of views on the role of small high technology firms and independent inventors in technological innovation. It is a subject of intense interest to my company and to me. It also is an area in which we lay some claim to competence.

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If I have learned anything in the past 25 years it is to challenge some basic shibboleths about inventions. The myth of the "better mousetrap", for example.

We've managed inventions, whose prospects appeared golden, which come to nought because of a variety of unforeseeable events. Our experience has been that fewer than fifty percent of the inventions which pass our rigorous screening and in which we invest time and funds on development ever pay back their investment and only ten to twenty percent of those will show a large profit. I might point out that on average only 2.5 percent of the inventions presented to us pass our initial screening.

Mr. **SHAMANSKY**. Thank you, Mr. Cairns. Mr. Abrahamson?

Mr. **ABRAHAMSON**. Mr. Chairman, members of the House Committee on Investigations and Oversight, I want to thank you for giving me this opportunity to present testimony on a subject that I believe is of critical importance to our Nation.

In the few minutes I have for presenting some prepared remarks I shall not give you a litany of the serious economic problems we are facing. Suffice it to say that I believe inflation and unemployment are unravelling the fabric of our society and solving these two problems is our highest national priority.

Instead of a litany, I want to give you some ideas about solutions. The ideas I am going to offer are grounded upon explicit recognition that small businesses, small technology based businesses, are the creators of a surprisingly large share of technological innovation in our country and of most of our new jobs, and yet they continue to have trouble raising capital.

Investors prefer less risky investments although society as a whole would benefit greatly if more money were available for taking and supporting higher risk activities. I should like therefore to make four rather specific recommendations to ameliorate the situation.

First, to provide more incentive for investment in high risk technology based new enterprises, we should reduce the capital gains tax rate for investments by individuals or corporations in qualified small businesses and we should defer taxes on sales of stocks if proceeds are reinvested within a short period of time in small businesses, except those small businesses that are mainly engaged in manipulating nonproductive assets.

We are pleased to note that a number of bills are pending in this Congress reducing capital gains tax rates to 21 percent or 17½ percent and providing for tax free rollover of gains. But these incentives should be limited, I believe, exclusively to investments in small enterprises.

Second, we should provide more opportunity for small businesses in their early years to establish a solid financial base that would attract investment and enable continuation of research and development spending in low profit years.

To do this, we should raise the threshold of corporate income taxes for small businesses which also, by the way, has been recommended by the Ways and Means Committee, extend the loss carry forward to 10 years and create a tax deferred research and development reserve fund.

Third, to expand the supply and stimulate the use of new and underutilized technology, we should provide incentive awards for federally employed scientists and inventors, tax credits to small businesses that buy and use new technology, and tax credits to firms and individuals that sell or license technologies to small enterprises.

And fourth, we should require each Federal agency receiving R. & D. funds to allocate 5 percent for technology transfer. We also note that Public Law 96-480, the Stevenson-Wydler Technology Information Act of 1980, calls for, among other things, each agency to set aside half of 1 percent from its R. & D. budget to support the technology transfer function.

This is a useful first step but it is only a first step. Let's consider, though, that the Agriculture Department spends 50 percent of its R. & D. budget on technology transfer. In that context, our 5 percent recommendation does not seem extravagant at all.

These I believe are the kinds of changes that we need to stimulate our small business sector so that it can regain its former role in making significant contributions to the growth of productivity, to the reduction of inflation, and decreasing unemployment.

Unemployment is the second of the most important problems we have. It is fully as important as inflation. To get at that, we simply have to create more jobs. But how? Well, the private sector has done a pretty good job over the last 10 years. We have created 15 million new jobs. But we still have high unemployment. Of particular concern is high unemployment among minority youth and among young people in general, and for women and older workers.

To create more jobs, I believe we simply have to create more businesses. Large firms can help in creating more buinesses. Large firms are not only the source of much needed capital, management, and other consulting expertise, but also of some of our most productive and cost-reducing technologies.

They have advantages accruing from large-scale operations and advanced information systems. They can work creatively and productively with small firms, and they can each take advantage of the benefits of the other. So we are talking about a cooperative arrangement between large and small businesses. Control Data has long had an interest in doing that.

We believe fervently that the future of our free enterprise system depends upon the continued existence of a thriving small business sector. For the past 5 years, we have been investing heavily an increasing share of our human and financial resources to address that objective, often in cooperation with Government programs.

In my prepared statement, I have described three of our principal initiatives. But I should like to conclude these remarks by summarizing a statewide ongoing effort in Minnesota.

About 2½ years ago, leading citizens in the Minneapolis-St. Paul area created the Minnesota Cooperation Office. The reason for the creation of this office was to assist in creating new jobs by assisting in the startup of companies. The MCO was not to be an investment company, but was to provide consulting advice to entrepreneurs struggling to start their businesses.

The hope was that the MCO could draw upon financial resources in the community and upon volunteers from academia, industry, government, and retirees to augment the knowledge and skills of its small staff. Well, that initial effort which we call the Minnesota model became a successful operating network funded by contributions from about 25 organizations, principally corporations.

Although the achievements have been modest over the first 2½ years of its existence, we can clearly identify 4 new firms being created in that period and 45 new jobs.

The benefit-cost ratio of this effort is astonishingly high considering that the net value to the community and the Nation of each of these new jobs averages about $80,000 per year. Furthermore, these results have been achieved without the benefit of any direct Federal budgetary support.

Having proved that you can do this, we now propose to expand that model.

We have a 5-year plan calling for the creation of 40 new firms and 2,000 new jobs over that period. We need some external funding, though, to get this expanded model operating properly. And so, we have proposed that the Federal Government supply that required external funding which is estimated at less than $400,000 for the first year and a little over $400,000 for each of the next 4 years. To reduce the budgetary impact, these amounts could be shared among the several departments and agencies that have an interest in technology development and application and job creation.

I believe this represents one of the few innovative proposals offered recently that shows clearly how technological innovation can be spurred to bring about increases in productivity and more good jobs.

I shall leave with you a complete copy of this proposal for inclusion in the records of this hearing. Thank you very much.

[The prepared statement of Mr. Abrahamson follows:]

Statement of

Sherman R. Abrahamson

Special Assistant to the Chief Executive Officer

Control Data Corporation

Mr. Chairman and members of the House Subcommittee on Investigations and Oversight of the Committee on Science and Technology:

I want to thank you, Congressman Gore, and your committee for giving me this opportunity to present testimony on a subject that is of critical importance to our nation.

In the few minutes that I have for presenting some prepared remarks, I shall not deliver a litany of the serious economic problems we are having trouble solving. Suffice it to state that because two of them -- inflation and unemployment -- obviously are unravelling the fabric of our society, I believe that solving these problems is our highest national priority. Instead, I should like to be more optimistic and to offer some ideas about solutions. These are grounded upon explicit recognition that small, technology-based enterprises are critical to our national economic health -- that they create a surprisingly large share of technological innovation and of net new jobs. Yet small businesses continue to have difficulty in raising and retaining capital. Investors prefer lower risk investments, although society, as a whole, would benefit from greater encouragement of risk taking. I should like, therefore, to make four recommendations to ameliorate this situation.

First, to provide more incentive for investment in high-risk, technology-based new enterprises, we should reduce the maximum capital gains tax rate for investments by individuals or corporations in qualified small businesses;* and defer capital gains taxes on sales of stock if proceeds are reinvested within one year in small businesses, except those whose principal activities are in manipulating nonproductive assets. We are pleased to note that a number of bills are pending in this Congress reducing maximum capital gains tax rates to 21 percent or 17.5 percent and providing for tax-free rollover of gains, but these incentives should be limited exclusively to investments in small enterprise.

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*Qualifications are: fewer than 500 employees, investment of 10 percent of gross revenues in R&D, and an employee stock ownership program.

Second, we should provide more opportunity for small businesses in their early years to establish a solid financial base that would attract investment in expansion and enable continuation of R&D spending in low-profit years by

(1) raising the threshhold of corporate income tax, which also has been recommended by the Ways and Means Committee;
(2) extending the loss carry-forward to 10 years; and
(3) creating a tax deferred R&D reserve fund.

Third, to expand the supply and stimulate the use of new and underutilized technology, we should provide incentive awards for federally employed scientists and inventors, tax credits to small businesses that buy and use new technology, and tax credits to firms and individuals that sell or license technologies to small enterprises.

And, fourth, we should require each federal agency receiving R&D funds to allocate five percent for technology transfer. We also note that PL96-480, the Stevenson-Wydler Technology Information Act of 1980, calls for, among other things, each agency to set aside 0.5 percent of its R&D budget to support the technology transfer function. This is a useful first step, but considering that the Agriculture Department spends 50 percent of its R&D budget on technology transfer, our recommendation for 5 percent is not extravagant.

These are the kinds of changes that are needed for small businesses to regain their former role of making significant contributions to the growth of productivity and thereby a reduction of inflation in our economy.

As for reducing unemployment, we simply must create more jobs. Jobs are at the heart of our society, but we do not have enough of them, and we are not creating new ones fast enough, particularly skilled jobs. Over the past 10 years the private sector has created about 15 million new jobs. This must be considered a noteworthy achievement. Over the same period, public sector jobs have increased by about three million. But even our best years of job creation have failed to bring unemployment below 5 percent of our labor force; and the rate of job creation has not been steady enough to prevent unemployment from fluctuating between 5 and 8.5 percent. Of special concern, however, is the lack of jobs for young people, minority youth in particular, and for women and older workers.

About 85 percent of the private sector jobs created ih the past 10 years have been in small businesses, firms with fewer than 500 employees. Being the main source of new jobs, the small business sector again must be called upon to generate most of our new jobs in the future.

More Jobs Mean More Small Businesses

To create more jobs, we must form more small businesses. While there are many opportunities in retailing, services, and well-established manufacturing industries, some of the most promising areas for new, small firms both to prosper and to contribute to society are in urban revitalization, development of small-scale agriculture and food processors, and the creation of high technology products and services. Successful formation of small businesses in such new fields requires cooperation among all sectors of society -- government with the private sector and large firms with small ones. Large firms are not only the source of much needed capital, management, and other consulting expertise, but also of some of our most productive and cost-reducing technologies. Moreover they have advantages accruing from large-scale operations and advanced information systems. Small businesses have advantages in innovativeness and flexibility, capable of exploiting short-lived and highly specialized market opportunities. In many situations efficiency is promoted by joining large and small firms to capitalize on the advantages of each.

While small businesses create most of our net new jobs, they are still only partially living up to their potential. Many small firms go out of business or fail to expand as quickly as they could because they lack access at a reasonable price to qualified, experienced business advice. This represents an enormous waste of entrepreneurial energy and determination.

Control Data Corporation has long had a strong interest in the maintenance of a vigorous small business sector in our country -- not only because it started as a small business just 23 years ago, but also because it believes fervently that the future of our free enterprise system depends upon the continued existence of a thriving small business sector. For the past five years we have been investing an increasing share of our human and financial resources to address that objective and often in cooperation with government programs. Let me briefly describe three of our initiatives in this area.

Business Centers. One of our subsidiaries is the Commercial Credit Company, a five billion dollar holding company. For many years, Commercial Credit has worked at supplying financial, leasing, and insurance services to the business community. Several years ago the company began a nationwide network of Business Centers, which are supermarkets of financial, insurance, and high technology, computer-based services all under one roof. Today in Philadelphia we are opening our 17th Business Center. In addition, however, we have established 52 smaller "satellite" Centers in locations where full Centers are not warranted as yet. Plans call for 24 major Centers and 72 satellites by the end of this year. In addition to a full range of financial, insurance, and business advisory services, each Business Center is equipped with state-of-the-art computer-based education technology. Our system is called PLATO. It is the most advanced and cost-effective way of delivering business and financial training in the world. It offers at least 100 different courses in business education, plus a computer-based examination of a person's business understanding that was developed jointly with the Small Business Administration.

Business and Technology Centers. Representing a new concept in assistance for entrepreneurs are our Business and Technology Centers (BTCs). A BTC provides various combinations of consulting, shared facilities, and services for facilitating the successful start-up and growth of new, high technology businesses. Called "incubators for small business" by The Washington Post, BTCs have been established in Minneapolis, St. Paul, and Toledo, and more are planned.

Each Center offers an array of services that are generally expensive and difficult for an entrepreneur to obtain. The regular lease for office and laboratory space ranging from 100 to 20,000 square feet includes such services as cleaning, utility, security, telephone answering, receptionist, mail processing, conference rooms, a technical laboratory, and library facilities. Of special attraction to technology-based firms is the availability of in-house compressed air and vacuum lines, extended venting and plumbing, steam, chilled water, and de-ionized water. These services are often exhorbitantly expensive for young, small businesses.

Finally, a BTC also makes available in-house training and education, using PLATO.

Business Advisors, Incorporated. A third initiative of Control Data is the creation of Business Advisors, Incorporated, a professional organization of experienced managers dedicated to helping small business grow and prosper.

Management assistance is especially important because small businesses lack funds to pay for the specialized expertise that is readily available on a substantial fee basis to large firms. BAI fills this need with management assistance services unique with respect to quality, diversity, and cost effectiveness for the new businesses. Accounting for BAI's greater cost effectiveness are the resources it can bring to bear on an entrepreneur's needs. In addition to its dedicated full-time staff, BAI makes use of a computerized skills bank that provides almost instant accesss not only to Control Data's highly experienced employees but also to experts in many specialized fields employed in other corporations and research centers.

To conclude this brief statement, I should like to summarize a state-wide ongoing effort in Minnesota. About two and one-half years ago, leading Minnesota citizens representing a cross-section of local society formed the Minnesota Cooperation Office

(MCO). The objective of the MCO was to create jobs in the private sector by assisting the start up of new companies. Each new enterprise would be based on an innovative product. The MCO was not to be an investment company but was to provide consulting advice to entrepreneurs struggling to start their business. The hope was that the MCO would be able to draw upon financial resources in the community and upon volunteers from academia, industry, government, and retirees to augment the knowledge and skills of its small staff.

That initial concept has now become a successful operating network called the "Minnesota Model." It has been funded by contributions from 25 organizations, primarily corporations. Although achievements of the model as expressed in quantitative terms are modest -- four new firms in 1980 which will have created 45 new jobs by the end of 1981 -- the benefit/cost ratio is astonishingly high, considering that the value to the community and the nation of each of the new jobs created averages about $80,000 per year. Furthermore, these results have been achieved without the benefit of any direct federal budgetary support.

Having proved that the process of creating jobs by identifying, transferring, and adapting new technologies to meet market needs can be accelerated, we now propose to expand the model by including all of the technology producing institutes and departments of the University of Minnesota. The plan calls for the formation of 40 new firms and the creation of 2,000 new jobs over a five-year period.

Accomplishment of the five-year goals of the expanded model requires some external funding. Because the model incorporates self-financing features, dependency upon external funding discontinues shortly thereafter. At the close of the period, the annual value to the nation of the jobs created up to that time, as expressed in 1981 dollars, will be about $160 million. The value can be expected to rise to well over $1 billion annually at the end of ten years, and correspondingly higher as time goes on. Clearly, it will be an investment that will yield handsome dividends.

Because the value to our nation of a successful demonstration of an expanded model is so high, we propose that the federal government supply the required external funding, which is estimated at less than $400,000 for the first year, and increasing to a little over $400,000 in the fifth year. To reduce the budgetary impact upon a single agency, the funding could be shared among the several departments and agencies that have concern for technology development and application and job creation.

The expanded model is expected to achieve not only the increased new business and job creation objectives. In addition, it will also demonstrate how a major university and private sector organizations can work with industry on a larger scale to speed the formation of successful new businesses and the creation of new jobs, requiring only modest federal budget support in its early stages. Such demonstration will provide valuable experience for facilitating replication of the Minnesota Model throughout our nation.

I believe that this represents one of the few innovative proposals offered recently that shows clearly how technological innovation can be spurred to bring about increases in productivity and more good jobs in the private sector, with a minimum involvement of government agencies in the process. I shall leave with you a complete copy of the proposal for inclusion in the records of this hearing.

Mr. Chairman, this concludes my prepared statement. I should be pleased to provide answers to any questions you and other members of the committee may have.

Mr. **Shamansky**. Thank you, Mr. Abrahamson. Gentlemen of the panel, I would be grateful if you would ask the questions. It seems to me that you are peculiarly well suited to inquire of this gentleman.

Mr. Kloss, would you like to begin?

Mr. **Kloss**. The proposal to expand the Minnesota model of providing what I think was what an earlier panel referred to as shovel money, is there a proposed mechanism that in other areas, States, there can be partial funding by private companies and the support of the Government?

Mr. **Abrahamson**. In this model, Mr. Kloss, we fundamentally derive the money, to operate it from the private sector, from contributions from corporations and other organizations.

We have done this for 2½ years. What we propose to do in the expanded model is to bring into it all of the technology producing faculties, departments, the institutes at the University of Minnesota. With the university playing a key role, selected technologies, would be recommended to a group who would look at them for their commercial viability. This would bring into play the Minnesota Cooperation Office, its board of advisers and other private organizations such as Control Data in the Minneapolis-St. Paul area.

Now to get the kinds of people into the university to help in the selection of appropriate technologies and the evaluation of them, we need a little extra money.

Mr. **Kloss**. It is to expand the Minnesota area, not to clone that into other areas?

Mr. **Abrahamson**. We would hope that this expanded model would be so successful that every State in the Union that had a technology producing center such as the University of Minnesota would replicate that model.

If we can create 2,000 new jobs in a 5-year period in Minnesota which is a relatively small community considering the Nation, and if you could replicate that in 10 or 20 other communities in the country or ultimately 100, I think you will have gone a considerable distance in reducing our unemployment and in increasing productivity and in improving the economic health of the country.

But we would like to have a concrete demonstration to point to.

Mr. **Kloss**. Large enough so that it is credible?

Mr. **Abrahamson**. So it is credible, right.

Dr. **Ramey**. Again to Mr. Abrahamson, you seem to be organizing a supermarket system for technolgy business. This is different from the A. D. Little approach. Would either of you sort of compare the merits of these two systems?

Mr. **Abrahamson**. I should like Mr. Cairns to respond first.

Mr. **Cairns**. I think it is an apple and an orange. I think the way to think of our system, our program, is to think in terms of the need we have to manage our own developments.

Having done that for many, many years we have gradually looked at a lot of outside developments and a few we select to manage on our own. We are not manufacturers and ordinarily these projects have a strategy of licensing rather than of startup. So I think the creation of jobs, the formation of new enterprise such as the major objectives of Minnesota as I understand it, are somewhat different than our objectives.

Our objective is to help promising new developments become commercialized with a small or large company.

Dr. RAMEY. The reward to the entrepreneur in your case is income from licensing?

Mr. CAIRNS. Yes, that is correct.

Dr. RAMEY. What is the reward system of the Minnesota model?

Mr. ABRAHAMSON. Let me cite or at least hypothetically cite a case that could well develop, that we would like to see develop. An investigator, a researcher, a professor in the Institute of Technology, of the University of Minnesota, develops over the course of several years a technology that he believes or that one of his colleagues believes has commercial potential.

This technology is brought to a group within the university, but also represented on that group are people from the Minnesota Cooperation Office.

That technology is looked at, evaluated for its commercial potential. Let us say ultimately it becomes considered to have high commercial potential. The professor then says, well, I want to go out of the university and into the private sector for about 2 years to see if I can't bring this idea to fruition.

The university has agreed already to permit that professor to do that, and it will guarantee him his post when he finishes his external tour. I believe that is a significant change.

Maybe he takes an office in our business and technology center. He won't have to but that is an opportunity there. That is a Control Data initiative, which is described in my statement. He works there and he expands his idea. He gets it ready for commercialization.

He really decides that he wants to license it to Arthur D. Little and get his reward that way, or he gets the MCO to find private risk capital and gets funding for it. He starts a business and he has equity in that business. But he says "I have done it and I don't want to stick with business. I want to go back to the university," and so he is permitted to do.

In addition, he has his equity in a business which is off and running. This is the kind of a scenario we would like to see. I think it is quite possible. In fact it is working. So the rewards then come variously.

Dr. RAMEY. He gets it through equity? You're actually tapping the research programs that are placed in universities by the various Government programs and bringing out individuals who have a higher orientation toward a specific technological objective.

How do you get business colleges to work with this when business colleges believe only in big business?

Mr. ABRAHAMSON. Control Data is big business but we are championing small business.

Dr. RAMEY. I mean business colleges?

Mr. ABRAHAMSON. I think there is an increasing recognition around the country of the importance of small business to our economic health. I think it also is beginning to be expressed, I'm happy to say, in the Reagan administration.

Dr. RAMEY. It is very unpopular with most deans. Rewards in small business of doing research are very few.

Mr. Abrahamson. Perhaps so, but the University of Minnesota is an exception. We have worked out this model in coordination with the university—with the deans and with the president.

Dr. Ramey. You have good ground to work on.

Mr. Abrahamson. I should think if we can get some funding to show that this model will work, I believe it would be a lot easier to replicate it. I think it's going to have a strong following.

Dr. Levin. If I might, I have a question for each. Mr. Cairns, first, you mentioned that ADL looks at a great many opportunities and selects very few of these.

I have addressed the fact that Federal agencies do the same thing. I'm not at all sanguine about their methods of selection by convocation of a peer group. They're likely to find true innovation beyond the scope of its purview. How does ADL make its selections?

Mr. Cairns. I will try to answer very briefly. Our measurement of success, I suspect, is quite a bit different from that of people in the Federal Government who may be evaluating technical developments.

Where I work, my report card is digital. It doesn't show the interesting technologies or the near misses or the almost list. But the thing that's important is the amount of money we're able to produce by betting on the right technologies.

Now, over the years, we have had an opportunity to make a lot of mistakes, from which we think we have learned something. I think our selection process is a very good reflection of the kinds of interests and capabilities of my company.

That doesn't mean that something we decide not to work with has little or no merit. It just means it is not for us. It is not the kind of business we should become involved with. So, we tend to favor things that, as an example, would be industrial, rather than consumer, that would be high technology by most people's definition, rather than the output of hobbyist inventors. The inventors we work with are well-educated people, highly regarded in their field, if not internationally famous.

Dr. Levin. It is an internal scrutiny based on your own expertise?

Mr. Cairns. That's right. As I say, the buck stops here. I'm the committee that has the final decision as to the things that we pick.

Dr. Levin. To Mr. Abrahamson, I'd like to say, "Sherm, we have to stop meeting this way," because we have been meeting at these panels now for about 3 years.

My question to you is, the points you have made in your prepared testimony, and so ably summarized in your spoken words, are points you have made before, and before, and so have I, and so have a whole galaxy of witnesses that have come before several of these panels.

The question after that preamble is, Why do you think we are still asking for these things that have not been granted by the Congress? The only adverse testimony we have had in all these years was out of the Treasury Department, which came, as you recall, with marching orders that anything that would reduce taxes was automatically off limits and they objected. All these other things have been testified for as strongly as mother's milk here a few minutes ago and yet with small exception, the bulk of this program has not been converted to law.

Mr. ABRAHAMSON. Well, that gives me an opportunity to expatiate at great length on what is wrong with our system. With great self-control and restraint, I will not take up your point that way.

I believe we continue to meet this way, Gil, because we belive so strongly in the importance of small business, high technology or technology-based small business. It is of critical importance to our economy to have a viable small business sector. That's why we continue. We will continue to meet this way.

At the same time, I believe we are making some progress: the Stevenson-Wydler Act that I just cited is a first step. Also there are pending in Congress some bills that contain a number of the things we have been talking about for these past 3 or 4 years.

Mr. SHAMANSKY. I'd like to ask a question. You heard me mention it earlier. I can sympathize with the importance of removing road blocks to entrepreneurship and innovation. I continue to be worried about lack of entrepreneurial activity and innovation absent road blocks.

What is it about our marketers? We earlier talked about the fact that the Japanese are using our technology. What is it about the American market that seems to defy the ingenuity of American developers or manufacturers to exploit it? Is it beyond their wit? Is it beyond their wit to come into our market just to have an idea?

You ultimately have to get it in a form that it can be used. What in the world does the Federal Government have to do with that? Why can't American business do something about that?

Mr. CAIRNS. Well, a problem relative to innovation that I would like to describe today, is that most people pay a lot of attention to startup problems—where does one get the capital, where does one get the shovel money or the seed money or the growth money, and so forth.

On the other hand, no one in this room today has spoken of the stimuli required to turn on large corporations so they will be more adventuresome technically, and so forth. But that's a whole other line of argument.

I contend that there is a very large resource in this country of inventions that are not ever going to get anyplace. Most of them don't deserve to get anyplace because they are wanting. But some of them, we have to assume, do have real value. We see them occasionally ourselves. Those things are not going to be the vehicle for forming a new company. The innovator doesn't have the interest or the capabilities of being that entrepreneur. The only way those things are going to have a chance is to have them managed, that is, commercialized, by another organization, a larger company.

It doesn't have to be huge, just another company. But to bring that invention to the point where it is attractive to the prospective licensee, and that's the business that I'm in, is expensive, and that capital is not available, Mr. Shamansky.

Mr. SHAMANSKY. Let me pursue this slightly. If we are going to have to broaden our definition of innovation or invention, as I understand it, we are not talking about a totally new gadget, but the adaptation of something to a particular need, a new consumer product in the music—or whatever those little things on the earphones as you walk along.

I guess what I find lacking and am appalled by is the idea that the General Electric or RCA are beaten out in the consumer area. I will pick up the Japanese, not that I want to make them our bete noir, but I traveled around the world and I see that they are meeting people's needs. It is not a genius idea. The technology is there. It's simply an attention to the needs, which I call a sensitivity to a market and a desire to go and get that market. Now, if the Harvard Business School sits on the same river that you do, it seems to me, and can't instill that in somebody, I can chalk that up to academics. But how about those hard-nosed market people, the retailers?

Mr. CAIRNS. Could I make a suggestion that Mr. Kloss is probably as well qualified as anyone in the country to speak on that country.

Mr. SHAMANSKY. I wish he would. I wish he would shoot me down.

Mr. KLOSS. The question is about business?

Mr. SHAMANSKY. That's my favorite example.

Mr. KLOSS. What is it about those products that one sees 3 or 4 years later done much better by someone else?

With respect to Government involvement it would be highly indirect in level of technical education at early years so that people have some better idea of how the world works, things that are possible and impossible, the knowledge that a perpetual motion machine can't be made, this basic engineering knowledge which exists widely in Japan among graduates that get into business and is absent here.

This is a highly indirect mechanism to support science and technical education at an early level. It is the absence of that knowledge of how the world works.

Mr. SHAMANSKY. You mean the absence of how the world works? Our corporate moguls can't figure out how the world works? That regard?

Mr. KLOSS. People in the position of deciding what products are made have a very poor, small understanding of simple technical engineering, the things that are possible.

Mr. SHAMANSKY. That's a frightening statement.

Mr. KLOSS. It is a frightening situation. I have profited well from that, so it is not sour grapes. But I think it is an accurate description. Those people that make the product decisions, given the structure of business, have a chance at making a major error and suffering from it. They have no way to benefit by taking this risk.

Mr. SHAMANSKY. How about the big companies that can spread that risk around?

Mr. KLOSS. The individual that decides to make it can't spread it. He made it or not. Walter is in that position, Mr. Cairns. But the people that make the product decisions will lose if the product is not desirable and if it does succeed, the fact that it contributes something to the company means little to them.

Mr. SHAMANSKY. Mr. Abrahamson is with a very large corporation and I know Mr. Cairns has contacts with people of that caliber, that level of society.

Mr. KLOSS. I'm talking about consumer products.

Mr. SHAMANSKY. I'm talking about consumer products. When these people go home, they see the kids have bought all the Japanese products, anyway. You would think they would be sensitive to it.

Accepting the truth of what you're saying, I marvel that that could be so. I'm appalled at the thought that the imagination of our business executives is so congealed in this area that they just can't imagine doing something in this area, making money at it.

Mr. CAIRNS. Mr. Shamansky, I'm not so sure it is a question of imagination, really. I don't think it's that as much as it is the manager is really being measured on a pretty short-term basis. As Mr. Kloss said, it is pretty obvious what the penalties are for being wrong and not so obvious what the rewards are for being right.

This is just the way American business generally works, quite different from the way a Japanese company works. If I may, I would like to just give a little example of two licenses that Arthur D. Little granted—one to a large Japanese company, the other to a major U.S. automobile manufacturer. They were to the same product. They shared the rights to a new kind of compressor for automotive air conditioners. We did the same kind of engineering work for both of them. We delivered prototypes to them. About a year and a half later, the U.S. automobile manufacturer had managed to test one new set of seals and they were doing that very intermittently at that.

The Japanese manufacturer had gone through three complete engineering redos so that they are new dealing with the third generation and they have finalized their production design.

They are now in production. The U.S. company has dropped their option and they will probably end up, or there is a chance they will end up, taking a license from the Japanese. Now, the technology was the same, attitudes were quite different.

One of the most striking differences to me had to do with the corporate commitment made by the Japanese. Before they decided to enter the program, the people at the lowest level in engineering, manufacturing, and marketing were committed or they negotiated among themselves to form a consensus that this was good for the company.

It boiled its way up toward the top so that when finally we were advised they wanted to go ahead, they weren't kidding. Failure was not an option available to them. It was a long-term, strong corporate commitment.

Mr. SHAMANSKY. By implication, then, the American company was kidding.

Mr. CAIRNS. The American company had many projects, Mr. Shamansky.

Mr. SHAMANSKY. I'm sure the Japanese company did, too. Why can't the American company—why that difference? You have described a difference but you haven't described a reason for the difference.

Mr. CAIRNS. I am not sure I know the reason.

Mr. SHAMANSKY. Let me pursue this slightly. As I remember, in my recent reading, where the Harvard Business School finally said gentlemen, we have been sort of missing the boat here. I am trying to think of some criticism from Lester Thoreau, your neighbor at MIT there. On the short-term sort of thing, what about our graduate schools of business in which we are the leaders in the world? What do they learn over there?

Mr. CAIRNS. I went to Dartmouth, so I can't speak to that. [Laughter.]

Mr. SHAMANSKY. I went to law school, so I am not apologizing for the business schools. I am wondering what is it that they talk about in these places. They teach by cases. What cases do they choose?

Mr. CAIRNS. If I may comment on that question, but not directly, over the years we have found some interesting things. When we have a development that will bring to, let's say, a dozen companies, we are telling precisely the same thing, the information is the same, and the reactions of those 12 companies are quite different. Now, we found—and this is a factor in our selection criteria—we found that if a new development does not lend itself to ready analysis, to straightforward analysis, there is very little chance we will interest a large company in it. There are a lot of people that work in large companies who are called venture analysts or they might be corporate development staff, et cetera, whose job it is to evaluate the incoming opportunity and make a decision as to whether you go forward.

Now, such analysis shows up in numbers eventually—return on investment and penetration of the market, et cetera. If it is a really new product like Mr. Kloss' projection television when it first came, or when man first had a facsimile machine that would operate in an office environment, the people would look at it and say,

> In the seat of my pants, I know you are right. But how can I go to my top management with only that feeling in the seat of my pants? I must have some numbers showing the amount invested and the amount we get back. That, in turn, means what our market share is. If there is no market, my analysis stops.

I think that is an important point, Mr. Shamansky.

Mr. SHAMANSKY. I regret, Mr. Cairns, it just raises the problem for me all over again.

Mr. KLOSS. What they don't teach at the business school is physics. The top three principals of Sony Corp. were all taught physics. They have interchangeably gone between engineering sales and production. That is the same reason that ideas like I had were rejected. There was an engineer who insinuated himself in a position of influence and adopted it. It is the analytic ability to determine whether a product could be made which is missing at the level that decides to make a product. This is a long-term very basic kind of thing.

Mr. SHAMANSKY. Maybe we need future accountants or lawyers or even salesmen at the top. Mr. Abrahamson?

Mr. ABRAHAMSON. Sir, I am with Control Data. Control Data is headed today by a man who founded the company. He is still an entrepreneur. He is our entrepreneur. He says, and speaking from a good track record over many years, he says we have become a society that is taking fewer and fewer risks. Our major corporations are headed by professional managers and their bottom line is the sine qua non of their existence, and that bottom line is a short-term bottom line. In contrast, he can get away with things that many of my colleagues cannot. I should like to make another point. There is an increasing concentration of power among business. When you look at the way mergers are going, you just wonder what does this mean for innovation in our country.

Mr. SHAMANSKY. What is—is business raising that? If a politician should ask that question, we would be shouted down as attackers of the free enterprise system. Where is that question—where in business is that question being raised?

Mr. ABRAHAMSON. Well, Mr. Norris has come to Washington over the past 4 or 5 years and presented testimony on this issue many times.

Mr. SHAMANSKY. Much reverberation in executive suites?

Mr. ABRAHAMSON. He has not developed a strong constituency there as yet. [Laughter.]

He advocates a social and economic impact analysis prior to mergers, and that both sides present to their stockholders their views, the pros and cons, of a proposed merger. And then the merger is voted upon by the respective stockholders. I think it is a highly innovative suggestion and it was greeted with great support by Senators Kennedy and Metzenbaum, I recall specifically, in the previous Congress. I hope he will have a chance to come to this Congress and give similar testimony.

Mr. SHAMANSKY. And any response from this administration? We will pass on that, Mr. Chairman. Thank you.

Mr. GORE. Thank you.

What was your discussion of mergers, sir? Can you clarify that for me?

Mr. ABRAHAMSON. I just raised the point in answer to a question of Mr. Shamansky, why we seem to be a less risk-taking society. It is clear that there is and has been for several years an increasing concentration of larger and larger business and there are fewer of them in principal industries. This means that the heads of these major corporations are professional managers rather than entrepreneurs.

Mr. GORE. Yes.

Mr. ABRAHAMSON. So this goes back to why we continue to be vigorous and vital—why we continue to need the vigorous and vital small business sector. That is why Gil and I continue to meet at places such as this and call for support.

Mr. GORE. Those flood gates have really been opened now, too, with the new wave of mergers. It is very, very disturbing to me. We were talking about shovel money earlier. I don't know what label you might use for all these enormous lines of credit being put together now. It was announced this morning that Gulf Corp. just put together a $4 billion line of credit just so they will be in a position to look for new acquisitions.

Other companies are put in a position where as a matter of defensive strategy, they have to put together a line of credit to fend off potential acquirers. The only way to defend yourself, as I understand the current business theory, is to get big yourself. Control Data is publicly traded, isn't it?

Mr. ABRAHAMSON. Yes, sir.

Mr. **Gore**. Have you had any corporate suitors in the last few weeks or months that you are aware of?

Mr. **Abrahamson**. No, I am not aware of any.

Mr. **Gore**. My intent is not to put you on the spot on this tangential issue. But it seems to me that your ability to concentrate on smaller businesses and assist in innovation very well could be hampered by the necessity in your corporate councils to concentrate on the larger fish swimming around out there that might be interested in gobbling up Control Data to put themselves in a defensive posture against an even larger fish.

Now, is that something that you have been forced to consider on your board?

Mr. **Abrahamson**. I heard Mr. Norris speak specifically to that point right here in this room. He said some years ago he was worried about it. But he is not worried about it anymore.

Mr. **Gore**. Has he had an opportunity to read the statements coming out of the Justice Department lately?

Mr. **Abrahamson**. He hasn't testified on that issue before this Congress.

Mr. **Gore**. I see.

Well, it seems to me that the crux of this issue for this panel has to do with the short-time horizons that large companies have and mergers within large companies, and the difference between what Dr. Mansfield referred to as a social rate of return and the economic rate of return which large corporations have to respond to. Somehow in this country, we have got to get a closer correspondence between those two rates of return. I don't know what it is. I don't know what the solution is.

Mr. **Kloss**. Could I make one observation? Is it that the large merger rate is inimitable to the rate of innovation? It would appear that it does open up that community of smaller companies for those who are the innovators to flourish. It also is a price for the small company to get started. But the absence of the medium-sized companies or the smaller companies only opens it up to make it easier for new companies to flow in, and that is where most of the innovation does come, from the formation of smaller companies competing against in the beginning the other small companies. As they move to larger companies, it does not inhibit the formation of new companies.

Mr. **Abrahamson**. I think the research that has been done in this area would be contrary to that position. At least, the studies that I am aware of conclude that there is a high positive correlation between numbers of business units and innovation. That is, the more business units there are, the better chances you have for innovation.

Conversely, the larger the business units, the smaller the rate of innovation. In our own company, we are not as innovative as we used to be when we were smaller. This has been a concern to the company. And yet, even knowing it, we have a difficult time coping with it. So, I think innovation—there is a relationship between innovation and size. The smaller the business unit, the more innovation. The studies I am aware of support that position.

Mr. KLOSS. I was addressing the rate of business formation and the rate of business absorption. The rate of business formation may contribute to innovation. Only a hypothesis.

Mr. GORE. That would lead you to believe that our antitrust policy should reflect that social advantage, wouldn't it? Or, would it?

Mr. ABRAHAMSON. Well, from a totally personal point of view—I have not been in a position to study this point. But from what I know about innovation and the causes, and what seems to stimulate it and what seems to inhibit it, yes, I would say that an antitrust policy that would favor smaller firms rather than larger ones would be good.

Mr. GORE. Thank you. I know there is probably some disagreement on that point from the people on the earlier panel. We are going to have to move on.

I would like to conclude this panel by thanking both of you very much for your assistance. We really appreciate it. I would move now to the university panel, our third panel.

It consists of two witnesses, Robert J. Mittelstaedt from the Wharton Innovation Center at the University of Pennsylvania, and Jerry Birchfield, the director of the Advanced Technology Development Center at the Georgia Institute of Technology.

Gentlemen, please make your way to the witness table. Your prepared statements will be put into the record.

STATEMENTS OF ROBERT E. MITTELSTAEDT, DIRECTOR, WHARTON INNOVATION CENTER, UNIVERSITY OF PENNSYLVANIA; AND JERRY BIRCHFIELD, DIRECTOR, ADVANCED TECHNOLOGY DEVELOPMENT CENTER, GEORGIA INSTITUTE OF TECHNOLOGY

Mr. GORE. Mr. Mittelstaedt, we will begin with you. We welcome you and thank you for your participation here today. You may proceed with the presentation of any or all of your statements as you see fit.

Mr. MITTELSTAEDT. Given the previous discussion, and being here as a representative of the Wharton School, I cannot start with a summary of my prepared text. I have to say something about management education, particularly at the graduate level.

I don't want to join the march of the lemmings over the cliff, for I think the reasons that management education is the way it is today is that we provide something the market demands just as anyone that produces any other product.

Unfortunately what is demanded by the marketplace is the professional manager. We recognize that as a problem. I am happy to report that within the Wharton School as well as other schools throughout the country, courses in entrepreneurship and innovation are at the highest levels they have ever been. A number of specific courses in our own curriculum are gaining interest among the students and are valued by the corporate recruiters who come to see those students.

The program that we have is a rather unique combination, called the management and technology program, of the engineering school and the school of business. At the undergraduate level, students get a joint major with a bachelor of applied science degree plus a bachelor of economics degree in 4 years. This responds directly to Mr. Kloss' concern about basic understanding of technical and engineering principles along with the business orientation.

In a longer period of time, they can receive a full engineering degree plus a bachelor of business. That is a 5-year program. Within the context of the educational program and as a clinical adjunct to it, we feel it is important to have a program which focuses directly on activities in the marketplace relating to commercialization of technology, formation of businesses—the activities that are necessary to get a technology into a format where it can be a viable business.

Most studies of the reasons that enterprises fail have focused on management in a generic sense. That frequently boils down to lack of understanding of markets and marketing principles.

Capital is cited as a problem, but it is a secondary problem more often than not. We hear about the lack of seed capital. That has been discussed this morning. We see that as a problem, but we see it as a problem which can be overcome.

As other panelists have indicated, seed capital is primarily a local phenomenon. I don't believe that there is much that the Federal Government or any other entity can do on a large scale, massive program basis to change that, other than through the indirect kinds of incentives that have already been mentioned. These have been studied on numerous occasions by Commissions and others.

Our program is designed to work with inventors and innovators who have a technology that they wish to commercialize. Because of the need that we see in the marketplace, we focus on doing market analyses, market research, development of a business plan, and act as an interfacing organization to help these individuals and firms come in contact with venture capitalists to put the venture capital together.

We do not act as a venture capital organization per se because we feel there are adequate sources, if, as someone said earlier, they can get the shovel in their hands, get the material put together which is necessary to access that system.

Let me, by way of summarizing the prepared testimony that you already have, simply say that our experience has shown it difficult to help inventors and entrepreneurs until they recognize a need for help. That is why I am not excited about organized programs that purport to do everything that the inventor or the innovator needs to have done for him.

There is an educational or maturation process, particularly for the person that is going through it for the first time. Simply learning the ways of the business world, what is to be expected, and the fact that he can't expect to retain 95-percent ownership and get the venture off the ground unless he has his own source of capital is traumatic for the investor.

Thus, I do not think that you can structure a system by funded program, regulation or any other mechanism that simply makes it possible for every inventor to get everything he wants. There is some education on his part that has to take place. As I mentioned before, we don't see a shortage of venture capital. The seed capital issue is a problem. I think it is encouraging to see trends on the part of individual investors, on the part of more and more large corporations—to put some money at risk. Even universities are putting portions of their endowment into things that previously would have been called high risk.

These are not huge dollars, but in terms of what is needed by individual inventors and innovators, they are significant sums of money. There is always going to be some good business that goes wanting, that is not recognized in its time. As I mentioned in the text, it would have been very difficult for Orville and Wilbur Wright to have funded an airline at that time. At the time they conceived the idea, that probably wasn't on their mind.

I don't see that there is an obligation on the part of society to make sure we find and reduce to practice every widget that every individual invents. We certainly want organizations, interface organizations, that try to bridge that gap, that try to help those that have the financing see the usefulness of a device if it in fact has usefulness. But we can't make the commitment or imply in the actions we take that every device that is invented has to find a use in society.

My final comments are simply that the approach we are taking, which we believe is somewhat unique, is to take an equity interest in a firm in return for the services that we provide. We don't charge a direct cash fee because most of these new firms don't have the cash to pay it. There are others that do this. Doing it within a university context is a unique approach.

We have a full time staff. We call on faculty. We utilize students and we draw on a set of resources from the Wharton School and the school of engineering and applied science that makes it possible to carry out such a program.

In the long term, while we have an educational mission as a very high priority, we intend that this has to survive as a business. My own responsibility as director of that program, ultimately, is to make it profitable for the university.

The Wharton Innovation Center is being supported totally by the Wharton School at this point with no other funding. But at some point down the road, in the 3 to 5 year time frame, we have to either begin to generate a positive cash flow or have interests in companies sufficient to prove that we are going to eventually be able to do that.

My point is that if the business of commercializing technology is profitable enough and if the indirect incentives are there to stimulate organizations to go into that business, we will be able to get the job done.

[The prepared statement of Mr. Mittelstaedt, Jr., follows:]

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Testimony Before The
Subcommittee On Investigations and Oversight
Committee On Science and Technology

U.S. House of Representatives

Robert E. Mittelstaedt, Jr.
Director

July 21, 1981

MITTELSTAEDT

I appreciate the opportunity to meet with you today to discuss the Wharton Innovation Center (WIC). The Center is a part of the Wharton School of Business at the University of Pennsylvania. Funding for WIC operations is provided totally by the Wharton School.

WIC began operations during the summer of 1980 with the following goals:

1. To provide educational experiences for students in the University's Management and Technology Program and MBA students with an interest in technology-oriented business.
2. To provide high quality business planning, capital formation, and management consulting services to businesses attempting to commercialize technology oriented products and services.
    a. to provide product analysis, market analysis, business planning and capital formation services to new firms or small firms with new products
    b. to provide management consulting, market analysis and technology planning services to large firms with a technology base.
3. To develop sources of support which will allow WIC to grow and provide maximum benefit to the students and companies involved without undue restrictions or concern for stability of funding.
4. To provide a vehicle for the commercialization of worthy technology developed by personnel associated with the University of Pennsylvania.
5. To provide long term financial return to the University beyond WIC operating needs.
6. To provide a source of "seed" capital for early stage financing.

As you can see from these goals, we are concerned with development of an organization which provides a "clinical" experience for students as an important adjunct to their formal education, while providing service to individual innovators and businesses on a financially viable basis.

The University established the Management and Technology Program as a formal joint program between the School of Engineering and Applied Science and the Wharton School about four years ago. When this program began at the undergraduate level, we recognized what we had been hearing from our external advisors, students and industry - that there was a need for formal education which combined the technical and management disciplines. This educational program has been extremely successful, with more than 200 students involved at the undergraduate level at the present time. Equally encouraging is the fact that the students have the highest level of incoming scholastic achievement of any group of undergraduates in the University. The program has been well received by students and faculty. Industry has responded enthusiastically by aggressively recruiting our graduates for a variety of positions requiring technical and managerial knowledge.

Recognizing the need to provide students with "real world" experiences in integrating management and technology, the Dean of the Wharton School made the decision in 1979 to support the establishment of the Wharton Innovation Center in conjunction with the Management and Technology Program.

Starting the WIC has been very much like starting a new business. While we have an initial captialization from the Wharton School, there is a limit to what we can spend and how rapidly we can expand our program. Like new businesses, we would like to be able to add additional personnel, capital equipment and expand our client base. Like new business, however, we must be careful about the rate at which we do this. Because of these constraints, we have defined our product in a relatively narrow area where we know we can meet a market need consistent with our program goals.

At present our focus with small firms is market analysis and business plan development and/or acting as a catalyst for capital formation. When we work with large companies, our focus is typically on the intersection of technology planning and strategic planning. Because of the interests of this group, I will confine my remarks to activities connected with new and small technology oriented businesses.

We see a major need for market analysis and business plan development in technology oriented businesses. These services are necessary to move beyond the individual who has a good idea to a business operating on a sound basis. We have repeatedly found inventors or innovators, within and outside the University, who have been working on technologies for 5-10 years, have usually acquired patents, have developed prototypes and have exhausted the traditional early stage financing available from family and friends.

Significant numbers of these inventors do not have business planning skills, do not have the desire to do business planning, or would rather devote their time to technical issues. Based on our experience, albeit limited, it is difficult, but not impossible to raise "seed" capital necessary to complete R&D through prototype development and testing. In the present environment there is little shortage of capital once the company is beyond this stage. With capital available and many inventors/innovators unable or unwilling to do business planning we see a need. It is our desire to help these individuals conduct the necessary analyses and business planning activities to facilitate initial business operations. Additionally, we get involved in on-going business consulting to help these orgnaizations be successful once capitalized.

In order to convince those with capital to invest, an entrepreneur must be able to show that he has:

1. A good product or innovation, preferably with protection through a patent or proprietary technology
2. A strong market with significant growth potential
3. Management capability
4. A plan for market penetration and growth
5. Financial returns commensurate with risk

In order to be able to show that he has evaluated and understands the items above, the entrepreneur must have examined and understand the following issues related to his product or service:

1. Competitive/substitute products or services
2. Distribution Systems in the industry and those proposed for his product
3. Market sensitivity to price, product design, and distribution
4. Production requirements and costs
5. Product limitations
6. Market potential now and in the future
7. Competitive strategies
8. Financial requirements

Obtaining and synthesizing this information for our client companies is our primary activity. The tangible product is a business plan prepared by a team of faculty, staff and students. It is used by the small firm to approach individuals and organizations with the capability to invest venture captial. We are not a venture captial organizaiton, nor do we have a desire to compete in this area where there are many competent providers. We do maintain contact with individuals and organizations with venture capital and continue to work on expanding our network in this area, since these are necessary relationships for successful completion of our work.

Our specific scope of work and financial relationships differ, depending on the stage of growth of the firm and the needs in its marketplace. However, I can make some general statements about these relationships.

We recognize that fledgling firms do not have cash to pay for the kinds of services which they require. We have structured a program where we conduct market studies, develop a business plan and make venture capital contacts for the firm in return for an equity position in the business. We have been using 5% of the firm as a nominal equity position and are still evaluating whether or not this is the appropriate level. We have made proposals above and below the 5% level depending on the stage of growth of the firm.

We generally sign an agreement with a firm for a period of six months to one year for completion of the activities described above, as well as general management consulting assistance. Our contract is not burdensome on the small firm and allows the opportunity for cancellation with minimal notice if either party is not satisfied with the relationship. In our standard arrangement, the small firm makes no cash outlay in connection with our services. This can represent a significant indirect investment in the firm on the part of the Wharton School and the University, thus we make some evaluation of the orgnaization and its potential before we decide to work with them. We recognize, however, that we are seeing products and companies at a very early stage and often take some risk which would not be justified at a later stage. It is possible for us to do this because, from an educational standpoint, our students will learn from successful as well as unsuccessful ventures.

In our one year of operation, we have had the opportunity to discuss possible relationships with 15-20 individuals and small firms. These have ranged from ideas in very early prepratory stages to those where the inventor has been working for 5-10 years and already has patents and a corporation formed and operating. We have declined involvement in many situations because of inadequate market potential, faulty technical concepts or lack of management capability, although management capability can often be corrected when capital is available. And yes, we have seen one perpetual motion machine as the solution to our energy problems.

We currently have contracts with two small firms with patented technologies and are nearing agreement on contracts with two other firms with patented technologies. All of these are organizations located on the East coast, with technologies which originated outside the University of Pennsylvania. We also have agreements or understandings with a number of inventors within the University, where additional technical work is needed before a product is available to be developed into a business.

Each of the firms above is less than 3 years old, has sales between $0 and $100,000 per year, has invested capital of $75,000 - $700,000 and includes dedicated people who believe in what they are doing.

We welcome referrals from qualified individuals and organizations. However, because of our limited budget and time for evaluation we are not advertising our services widely. We would like to have an individual or organization conduct at least a preliminary review of a technology before we see it. We have found a number of state and local agencies, faculty members and business people willing to do this.

The technologies of the firms mentioned above include air pollution control, moveable insulation for windows, computer controlled displays, and mineral beneficiation. We have worked with one of these firms long enough (1 year) to know that it is likely not to make it. The others are still not in the black, but look promising. The failure will be labeled inadequate management, a situation we attempted to correct for some time, unsuccessfully.

Ultimately, our evaluation of success will be that of any businessman: financial success and growth of the firm. As interim measures we believe that we are successful if the firms we work with raise venture capital with our assistance, and if the students invovled in the projects have worthwhile learning experiences.

In summary, and by way of response to the issues raised in Congressman Gore's letter inviting me to testify, I believe that the following lessons we have learned are pertinent for your consideration:

1. It is difficult to help inventors and entrepreneurs until they recognize the need for help. No system, structure, or financing arrangement will substitute for experience and understanding regarding the way the world works. Once these individuals reach the point where they seek help, there is a need for organizations which act as a catalyst between the individual inventor or small firm and the financing community.
2. At the present time, there is no shortage of venture capital and in a society with increasing affluence, the more we improve the tax incentives for investment, the easier it will be for inventors and entrpreneurs to raise capital. However there is a need for high risk "seed" funding necessary for prototype completion and initial operations.
3. There will always be a good invention, a good business or a good inovation which will go "wanting", because "no one understands" and thus capital is not available. Orville and Wilbur Wright could not have capitalized an airline in the early 1900s, in fact they even had difficulty convincing the military to invest in their innovation. We do not feel an obligation to find a use for every widget we see. We attempt to gain insight into the innovators' thoughts, consult others and daydream a bit, but there will never be a use for every patented device.

My final observation is that while small firms and inventors need help, I am concerned lest "the tail wag the dog." Sometimes I have the feeling that before long there will be 25 coordinators, business planners, venture capitalists, large corporations and others looking over the shoulder of every inventor and scientist in the United States waiting for him to add the last drop of the proper chemical or design the final circuit that will produce the invention which diffuses overnight into a $2 billion dollar market. While these individuals and firms and this country need assistance to deal with innovation, I hope that we do not embark on a uniquely American "lets put an inventor on the moon" project. I believe that it is quite possible to invest significant sums of federal money in support and assistance programs to deal with things which the private sector has rejected with good reason.

Mr. GORE. Thank you very much.

Mr. Birchfield?

Mr. BIRCHFIELD. Thank you, Mr. Chairman.

I am glad to be here today to describe some of the things we have been doing down in Georgia, Georgia Tech. We started several years ago working with the State government and the university to develop an advanced technology development center.

The concept at Georgia Tech is to fill a vacuum that exists in the southeastern part of the United States, especially in the technical arena. We consider our program from a technical sense as an "impedance match"—it matches sources innovation in the private sector with the Government resources for the benefit of the entrepreneur.

The program has been underway for a year and a half and has three principal elements. First, as was mentioned earlier this morning, it includes an educational component. We are not educating students per se, but we are educating bankers, financial parties in the State and in the Southeast, and entrepreneurs. We are trying to show them that investments in technical risk areas can pay off as well as investments in nontechnical areas.

In the Southeastern part of the United States, we have a continually growing real estate market and consumer marketing outlets have been going on in that area. Investments by bankers and financial houses in real estate, in marketing, and so forth, have been very easy to come about over the last few years. Investments in technical areas, though, are rather limited.

The technique, the technology for investment in technical areas is just not there. Also, the source of venture capital is not available in the Southeastern part of the United States. So we are working both of those sides of the street in the education area.

The second major thrust is basically to go out and try to convince people who have already located high technology firms to move some of those firms' activities into our State. It is a rather traditional role that most States carry forward.

We are focusing though on high technology firms. We have had many consultants advise us, consultants from Silicon Valley in California after having started companies and retired to the hills overlooking the bay. We have asked them to come off their hill and talk to us.

They advised us that if we really want to start in the high technology area quickly, to not wait around through all the failures while the small businesses start and fail, but instead to locate companies and let there be a layoff so that you have got dissatisfied engineers and they will start your companies for you.

We are not advocating layoffs, but we are going to get companies in Georgia large numbers of potentially dissatisfied technical employees, we hope.

Mr. GORE. Our new policy may be just what you wanted. [Laughter.]

Mr. BIRCHFIELD. Maybe, especially if Clinch River goes. The third element is more directed to the entrepreneur. This has received the bulk of our activity. We put half of our resources on this particular area.

We constructed what we think is a unique experiment in starting high technology businesses. We have created an incubator facility which allows a small high technology company to have a front door that opens into the world and a back door that opens into the roughly $200 million of Georgia Tech's physical plant that the taxpayer has paid for already.

We try to be the impedance match between an entrepreneur's needs and the professors who have the technology and equipment but don't understand how to operate with the entrepreneur.

We also try to help the entrepreneur—I differentiate between the inventor and the entrepreneur—we try to help him help himself as he goes into business. We will not do a business plan for him but try to point out things he should do to set up his own.

We will not loan him money but we will give him a list of a dozen or so venture capitalists, and say go to it. We look at the problem of how does a person raise venture capital, how does he attract $200,000, $300,000, $400,000, $500,000 and move forward?

At first, we expect that person to have put up the first $10,000 to $20,000 out of his own pocket. We will help him move from that $10,000 to $20,000 position to the $300,000 or $400,000 or $500,000 position.

We have two active companies in our incubator.

Funding patterns for this program are interesting. It has no Federal money in it. We have roughly one-third private sector money which comes from friends of Georgia Tech. The other two-thirds of the financing has come from the State of Georgia.

The Governor of the State of Georgia is extremely interested in this area personally. He has led the State in investing approximately $2 million in this program area over the last 2 years.

Thank you.

Mr. GORE. Thank you very much. Mr. Kloss or Dr. Ramey, do you want to go first? Go ahead.

Dr. RAMEY. We have a couple of approaches here, one from what seems like a technological and business background and the other straight out of a business background. I wonder if either of you would compare your two programs in some respect or another so we can understand how you differ in what you do?

Mr. MITTELSTAEDT. I don't know that much about Mr. Birchfield's program but from listening to what he said, I will try to compare our programs. It sounds as if one difference is that he is focusing on space and physical resources necessary for the firm to actually get started.

That is something that we have not yet done. Our program simply is not very old. It is only a little over a year old. It is something that we will consider doing in the future but that we have not seen as a major need yet.

The environment in which we exist may be somewhat different. In Philadelphia, there is the University Science Center adjacent to the university. It is relatively easy for a small firm to acquire space, access to laboratory facilities, testing facilities through that organization. It is not necessarily the cheapest source, but these are sources that are available. It is not a need that we have to be involved in at this point.

Mr. Birchfield also commented that they do not actually prepare business plans. We are engaged in that activity. I know that there is a difference of opinion in the world as to whether or not you ought to have an outside organization help you with your business plan.

When I say that we prepare business plans, this is an intensive iterative kind of a process. It is not something that we do in abstract at all. It is not simply done by a third party and handed to the individual inventor. It is something that is done with his total involvement in the process.

Those are the major difference which I perceived as he spoke.

Mr. **Birchfield**. I think the principal difference probably is in the depth of the technical capability that is provided for the entrepreneur and probably the limitations that our program would put on the class of entrepreneurs that we deal with. Ours almost exclusively are technological in nature.

Mr. **Mittelstaedt**. Ours are as well.

Mr. **Birchfield**. The space is not so important to the particular entrepreneur in my opinion as it is to the community of entrepreneurs who perceive that there is something going on in the entrepreneurial development arena which attracts them to the center and allows them to take part in the center's activities and may even give them the nerve to step across the edge and go ahead and carry their company forward.

I presume you carry on other program elements through other parts of the Wharton School, the education and the financial community, so we don't differ there.

Probably in the attraction of outside large companies to locate in the area would be another difference.

Dr. **Ramey**. If there is anything our last two panels told us, it was big business is not the place to initiate a new business if you are an entrepreneur. So obviously, you're doing something different.

You're able to measure this difference or at least your customers are able to measure it in some way. They must tell you that they would rather be with you working than to be in a big business. Can you tell us what are these rewards that bring them in such numbers to you?

Mr. **Birchfield**. They are typically financial.

Dr. **Ramey**. You mean you pay them?

Mr. **Birchfield**. No, they get paid themselves as much as if they were working for themselves, and in some cases, more.

Dr. **Ramey**. So it is the payoff?

Mr. **Birchfield**. The payoff is extremely attractive.

Dr. **Ramey**. You're saying you have opened your doors in each case in vastly different places and the entrepreneur showed up and went to work?

Mr. **Mittelstaedt**. I think there is an interesting thing beyond the return from the operation of the firm itself that the entrepreneur sees as an advantage in working with us, particularly at the Wharton School. Many of them do not want to work for a large firm, but are interested in whether or not a large firm will invest in them from a venture standpoint. Particularly for the inventors that we see that are over 50 years old, large corporations are seen in a position to buy the firm from them entirely at some point, when they are ready to retire.

In a number of situations that we have been involved in, we have ended up working as an intermediary between the small firm, the entrepreneur, and a large well established firm with which we already had existing contacts.

That is a situation that I'm not sure that we even fully intended as an advantage when we began, but which has surfaced as an advantage as we have gone along.

Dr. **Ramey**. You seem to need no financial help. That surely can't be entirely true. Of course, you're backed by universities. Are there things within the law or changes in the law that would allow the activity you're engaged in to be promoted more broadly and quickly?

Mr. **Birchfield**. Well, I think that each area of the country is going to develop its own particular kind of entrepreneurial innovation center. I think the local conditions dictate local kinds of solutions. I'm not a tremendously great advocate of the Science Foundation, the National Science Foundation. However, I think that probably the programs that have been carried out by the Science Foundation in the innovation area, not those studies—not those programs which studied innovation per se, but which established the centers——

Dr. **Ramey**. The experiments?

Mr. **Birchfield**. The experiments that were carried out. I think we learned some things through those experiments and I think we should do other experiments. The four or five that were carried out, the million or $2 million which was expended simply is not enough to learn enough about this very difficult problem.

So not so much for us in Georgia—I don't know. You may need a contract or a grant. Not so much for us in Georgia, but other people can take advantage of the Science Foundation program and we should encourage expansion of those programs.

Dr. **Ramey**. CDC is an example of university-innovator bridges. Is this a crucial method allowing this country to use its investment in R. & D. when this sort of bridge is established?

Mr. **Birchfield**. I think we have the traditional communications problem. I think we have a large reservoir of talent which is expending itself basically on internal work that's going nowhere.

Dr. **Ramey**. Writing papers?

Mr. **Birchfield**. They are papers as well as perpetual motion machines. Both kinds of bad things go on. There is a lot of public investment in the national labs and the public universities in this country. We have not learned how to couple those two together. I think these are the kinds of experiments that need to be carried out.

We simply are trying to communicate with entrepreneurs and with Government and with our resource base and then get out of the way. We think the magic will happen after that initial communication is carried out.

Dr. RAMEY. I could talk to these men all day.

Mr. GORE. Dr. Levin?

Mr. MITTELSTAEDT. Let me make one comment about the question Dr. Ramey asked about the need for help. I don't want to imply that we don't need help, because I do have to continue to have the funds to make this program viable. We could expand the scope of what do and number of companies we work with if we had more resources.

But I have been in the university long enough, 8 years, to have had experience with programs funded from State and Federal sources running from the war on cancer to the war on health care management to the war on a couple of other lesser things along the way. I have come to the very strong belief that this is not a very efficient way to do things; that while there is some good being done in all of these programs, it is relatively small, hard to measure, difficult to document, and difficult to excise politically once it's been put into place. So, I am searching for the things that Government could do to help as well but I want to make sure that I let everybody know that I am not advocating a massive put an inventor on the Moon project.

Dr. LEVIN. Mr. Chairman, you said you were soliciting comments as well as questions from the panel?

Mr. GORE. Yes, absolutely.

Dr. LEVIN. I wanted to mention another university-small business arrangement that our own company established last year with the Johns Hopkins University. We put together an agreement by which we formed a governing board for the Biospherics-Johns Hopkins Joint New Product Venture.

Its clearly defined objective is to develop and commercialize new products for profit, underscored, which was quite a startling break in the tradition, at least at that university. I am told it had been attempted once a decade or so earlier, unsuccessfully, as a result of general faculty attitude. Today's attitudes, however, already remarked upon by two witnesses, are that people are recognizing dwindling dollars and inflationary bite so they are interested in moving into profitability.

Mr. GORE. If I may interject, this committee has held a number of inquiries and held one hearing on some of the new arrangements in that overlap area. Some of them raise troubling questions. These questions are now being addressed as well by NIH. We intend to have further hearings on that subject. It's obvious that this trend is accelerating. But there are good agreements and bad agreements and there are some pitfalls to be avoided, as well as some opportunities to be seized.

Dr. LEVIN. Yes, true. In our instance, the governing board selected two projects to start with. It turns out that either group can propose an idea and we have a matrix which indicates how we share respectively in the royalties and profits. The share depends on the contributions: Intellectual contributions, capital contributions, facilities and personnel. From our standpoint, we have access to excellent personnel whom we could not afford to have full-time and we hope in the future to have access to facilities as well. From the university standpoint, we are a spur to get something going to involve its faculty in additional productive efforts.

The joint venture idea came as a result of hearings I participated in earlier in which the need for university-small business cooperation was identified. Several of the Government agencies expressed an interest in supporting such associations. But a problem has developed. We found, by the very act of saying this is not just a mechanism to support graduate students or augment the income of faculty with soft money, but we are really interested in specific products for profit, that these Government agencies now say, "Hey, we can't help you because you're talking about specific products. If you were talking about general concepts that did not reduce to practice, then we would give you money."

This is kind of a dilemma for us. To date, the only funds put into the joint venture was the initial $50,000 that my company contributed.

And so, we are now looking at other financing methods. You mentioned State and private sectors which might contribute to this sort of thing. That did not go unnoticed. But our joint venture differs from the two described and I thought it might be of interest.

Mr. GORE. Thank you. Mr. Kloss?

Mr. KLOSS. I have no particular questions.

Mr. GORE. All right. I would like to thank you very much for your participation here today. It's much more available to us. We appreciate it.

Our fourth panel consists of two venture capitalists, Peter Gillespie with Technology Partners, out of Chicago, and Peter Vollers, with International Technology Resources, Inc., from New York. We would like to hear about the availability of early-stage funding for prototype development, innovative financing approaches, including research and development tax deductions, other assistance that might be available and the limitations on venture capitalization and any concerns or suggestions that our witnesses might have.

Without objection, your entire statements will be put in the record.

We would like to begin with you, Mr. Gillespie. Welcome, and thank you for joining us today.

STATEMENTS OF PETER GILLESPIE, TECHNOLOGY PARTNERS, CHICAGO, ILL., AND PETER VOLLERS, INTERNATIONAL TECHNOLOGY RESOURCES, INC., NEW YORK, N.Y.

Mr. GILLESPIE. Good afternoon, Mr. Chairman. I am a managing partner and founder of a new firm that is organized to address the subject that we have been talking about this morning and am therefore very pleased to have the opportunity to present our thinking in terms of the structure of our activities and how we feel it represents a significant potential solution to the shortage of capital for very early-stage technology developments.

By way of background, I'd like to tell you a little bit about myself. I spent the last 7 years in the venture capital business with Heizer Corp. in Chicago, one of the Nation's largest venture capital firms.

Before that, I spent 5 years at Johnson & Johnson in a planning and marketing function with that company. Early in my career, I was a practicing chemical process design engineer in Boston for 5 years.

I also in the course of my career spent 2 years at the Amos Tuck School at Dartmouth, the business school which has come in for some knocks this morning.

I feel that my background and a number of other business school graduates are in fact interested in the process of innovation and are personally making significant contributions to the problems we are discussing today.

I will depart from my prepared testimony and quickly summarize my view of the venture capital industry, because I think it is important to understand what we mean by venture capital and what it does.

And then, the changes in tax policy which make our activity possible and to spend a reasonable amount of time explaining just what we do and how they are a direct outgrowth from changes in recent tax policy.

In terms of the venture capital industry, I think it is important to keep in focus that it is a very new industry. In writing my testimony, I targeted 1948 with the formation of American Research & Development and the Small Business Investment Act of 1958 as really the beginning of the industry.

My assessment is that we have done spectacularly well in terms of putting together 100, 120, 125 firms staffed by very competent professionals working full-time on the process of financing innovation.

Second, I went through in my testimony a report developed by the Venture Capital Journal which Dr. Shapero previously mentioned, and I agree it is probably the best source of data about what's going on in the venture capital industry. That report published in 1978 basically looked at where venture capital funds were invested during the 1970's and identified areas of significant capital gaps.

The gaps that they identified at that point were in established companies, with sales $10 to $100 million. They were greatly constrained in their ability to grow because of the inability of the financial market to provide support.

The remaining two areas are the ones that we are talking about here today, significant gaps in the availability of startup capital and below that, the more risky end of the venture capital spectrum, seed capital investment.

Since 1978 and I think everybody recognizes with the passage of the reduction in the capital gains rate, there has been a substantial flow of funds into the venture capital industry.

That flow of funds, coupled with renewed vitality in the public markets have eliminated the first problem. And, from our perspective, contrary to what Professor Shapero indicated this morning, the venture capital industry has moved very aggressively into the financing of very early stage develoments and provided startup financing to quite a number of companies around the country. But in spite of that, I intend to argue that there remains a shortage of venture capital for very early-stage technology developments. And, I would like to quickly present our analysis of just why that occurs. It requires some understanding of the structure of the venture capital industry, where the funds come from and also where the demand is for venture capital.

Let me start on the demand side. In the mid-1970's, the word was out in the press that venture capital was dead. It in fact was very close to being dead.

There were very little funds available. That served very effectively to turn off the entrepreneurial spigot. One of the other issues that was addressed in the course of the testimony is, you know, why aren't big companies doing the job?

I think it is important to recognize that big companies are probably the greatest source of the builders of new companies. It's not your typical garage inventor who is going to form, the major companies of today.

These people are very sharp, very well educated, and they just don't jump out to form a new company when there is no capital available.

So that the demand for capital dried up coincident with the lack of its availability. It's a chicken-and-egg situation, but with the capital gains tax reduction more money came back in, and the entrepreneurs came out of the woodwork to help strengthen the public market for new companies.

Interest is focused in this area and people have come out and in our judgment will come out in increasing numbers to start new companies over the foreseeable future.

As the venture capital industry has grown, magazines like Inc., Venture have recently been developed to support it. These magazines have built very large circulations which reflect the degree of interest in the area.

They go a long way toward explaining to the entrepreneur the realities of starting a business and telling him where capital sources are. There is an infrastructure beginning to be developed which makes it much easier for a would-be entrepreneur to seriously consider the prospects of jumping out and starting a new company.

Given that, when you look at the venture capital community, they have, as I said previously, significantly increased the amount of their support of startup ventures.

But there are some factors which limit their ability to do so. First, they get their funds principally from institutional sources who are significantly constrained by virtue of their fiduciary responsibilities on the kind of risk investments that can be made.

And that responsibility flows down into the venture capital community. Studies that I quoted in my testimony indicate that during the 1970's, 20 percent of the invested dollars went into startups.

I subsequently talked to Stan Pratt in Boston, the publisher of Venture Capital Journal, and he said if one really looked hard behind those numbers, it was probably more like 10 or 15 percent.

His assessment today is that startup financing has moved up in the 25 to 30 percent range.

It's his view and mine that that's probably a level that it's likely to stay at in order for professional venture capital firms to balance the risk of what they are doing and to maintain acceptability in the eyes of the institutional investor who is providing the funds.

I don't have data on the total number of people who are involved in the startup of firms, but the Charpie report which Professor Gellman was involved in and was mentioned here this morning indicates that one of the major difficulties with very early stage company formations is the appraisal problem. They label it an appraisal gap. Well, that is a very time-consuming responsibility. To a venture capitalist, time is really their scarce resource when one understands the business. So given the absolute number of people in the business and their investment philosophies of risk balancing in their portfolio one can only expect venture capital firms to do a finite number of early-stage investments.

The last consideration, then, is a description of the operation of the venture capital industry. The kinds of startups they are doing are the very experienced technologists combined with businessmen, such as the strong teams who come out of a Hewlett-Packard or out of a major company with the business and the technical base covered. Having both of those present significantly reduces the risk that a venture capitalist has to face.

The venture capitalist also is more likely to look at industries where he has invested in the past. This means the electronics-based-type investments, computers, computer peripherals, communications, the things that have received a lot of attention from these venture capitalist firms over the last 10 or 20 years. So, Mr. Chairman, you can quickly begin to see who are the people who will have difficulty raising capital.

It is in this group that we think the problem exists.

From my personal perspective and that of my partner, there is a resource out there in the economy that is likely to go untapped if changes, which I will address next, don't continue to take place. Basically, it is the technologist without a good business partner along with him or the wrong business partner. Or, it is an even sounder theme that is operating in an area that is outside of the venture capital industry's current expertise. There was some conversation earlier about the fad nature of the biological sciences. Well, that is a plus now. But when some of the mistakes begin to surface, the fad could go away and people could start to shy away from that kind of investment because it is really an area that I feel most of the venture capital community is in water over their head right now.

So that I think it could well be difficult for people in this area to find venture financing in the future. Another difficult area for the new enterprise sector to address is in the energy and energy-related activities. That is a new area for the venture capital industry. They are moving into manufacturing productivity anaerobics but that is a little bit at the end of the spectrum. So people who are in those areas, and if they don't have solid teams together, are the ones who have difficulty raising funds.

The other side of the question which I don't think can be avoided is that in any startup situation, the venture capitalist, because of his perception of the risks involved in the investment, is going to demand a very high percentage ownership of the company. Very often, entrepreneurs find that onerous and get discouraged by the process and in some cases, I believe, fold their tent and we don't get to see some developments emerge which society would be better off if they in fact did.

Given that preamble, then, what should the Government do to attract more capital and entrepreneurs to provide productivity and enhance technological developments? From our perspective, the machinery really is in place. Professor Shapero and a couple of other panelists this morning correctly indicated that for seed capital and very early stage investments, has typically in the past been the province of wealthy individuals and people on the local scene whom the entrepreneur can go to. I would qualify that to say that the very solid groups can step out and attract venture capital right off the bat. But the people who I just identified as the ones who are likely to have most difficulty raising money are going to raise it from this pool of capital, the wealthy individual.

In my prepared testimony, I described at length changes in recent tax policy which permit the formation of R. & D. limited partnerships which is beginning to significantly enhance the flow of capital to very early-stage developments. We feel that it is very important to recognize the risk-sharing dimension of just what this piece of legislation does and how it provides for the increased flow. In our judgment, it removes the roadblocks, the important roadblocks, in the process by providing the correct incentives that are going to facilitate the flow of capital from wealthy individuals into this sector of the venture community.

Page 21 of my testimony lays out a little bit of a chart which I think helps to put in perspective just how this mode operates. First, the Government, by virtue of providing an immediate tax writeoff to the investor, accepts part of the risks in terms of a delay in tax revenue in anticipation that it will receive future capital gains upon the success of the investment and more importantly, additional future tax revenues from the new company when it is successful. The wealthy individual, even though he gets a tax break in the first year, takes a substantial venture capital risk in anticipation of a future royalty or equity or some combination of the two. I should stop for a minute to put in perspective that R. & D. limited partnerships address not only the startup question, the new forming company, but also is a financing device which is being used by the young technology company that is still tightly capitalized, that is trying to maintain its earnings growth. This provides an off-balance sheet form of financing that permits them, in our judgment, to accept greater technical risk and it enhances their ability to expand their business and develop the technological base that many of these companies have resident in the company.

So, it works in terms of facilitating new startups and facilitating additional technological development within any size company. But our attention is directed primarily toward the smaller capital constrained growth companies.

The next dimension to the process of the R. & D. partnership is that qualified people like ourselves screen the projects that we take to the perspective investor and we continue to work as the venture capitalist does in addressing the management issues, the marketing issues, and in some ways doing much the same as the previous panel talked about doing in the innovation center, working closely with the entrepreneur to get him on the right track, to put the right people in place to make a serious business out of it. The importance of this legislation is what it permits firms like us to do. Our incentive combination is alined with the investor. We can take sufficient income out of the funds invested by the investor to cover our overhead and salary. But the bulk of our incentive comes from the long-term success of the development. So that I think this is a major advantage in that a lot is at stake and our return is coincident with the long-term success of the venture. We believe that that is a significant element that should not be lost sight of.

The fourth dimension is that because of our backgrounds, we already have established linkages with the venture capital community. So that we at the appropriate point, sometimes very early, will bring in a venture capital firm along with us to insure that the company is connected with the venture capital industry in order to attract the additional and significant capital it needs to achieve cash flow break-even and long-term stability.

A last point goes to an important area for the entrepreneur. The R. & D. partnership permits him to give up much less ownership, front-end, and provides him the opportunity to demonstrate technical and economic feasibility, hopefully for his development which when one looks at it, in reality, it is taking a lot of the risk out of the program, so he is going to be able to attract, follow on capital at more favorable pricing to him and therefore create an improved incentive for him to step out into the arena.

So, we think all of the developments are very productive. I will be very surprised if we don't see in the R. & D. partnership area the same kind of things we have seen emerge in the use of partnerships to enhance independent oil and gas drilling and also in the real estate areas.

That implies there will be successes and there will be problems. What I would urge on this committee and the Congress is tax-base incentives. Very often there are sectors of the government that want to shut down the tax benefit without really looking at the other side of the equation to fully understand just how that tax benefit is operating in the economy. What could be, I think, very detrimental is an unstable mode of regulation or complexities introduced downstream that make it onerous to use this type of financing. I hope that does not transpire.

Lastly, in terms of recommendation, we would like to have you and the Congress consider that the administration's proposed R. & D. tax credit to entrepreneurs and to universities be passed and that the R. & D. tax credit for increased R. & D. investment in companies, that that be allowed to flow through to the limited partner investors in very early-stage companies. I don't understand how that legislation now sits, but there was some talk that that would not be permitted. In our judgment, that creates a discrimination against the early stage investor in favor of—or even the young company who does not have a lot of profits—in favor of big business.

So, the ability to flow that credit through if it hopefully passes, to the limited partner is going to be, I think, a significant benefit.

Mr. **Gore**. I am going to have to interrupt you. We have a vote on the floor on social security. We will come back in 10 minutes.

[Recess.]

Mr. **Gore**. The subcommittee will come back to order. I apologize for the brief recess. Mr. Gillespie, you were about to conclude, I think.

Mr. **Gillespie**. Yes. I had one final brief recommendation, and that is that a reinstatement of the qualified stock option, I think, will be another important incentive to attract more people into new business formation. So, I would like to put a vote in for that. And to close, I would like to say that we feel it is entirely appropriate for the Federal Government to finance very basic research, scientific research. It would be very healthy for the economy. But the kind of incentives, particularly in the tax area that I talked about in my presentation, are the appropriate route to enhancing increased innovation.

Thank you.

[The prepared statement of Mr. Gillespie follows:]

STATEMENT OF

PETER J. GILLESPIE

Managing Partner, Technology Partners

STATEMENT

Good morning, Mr. Chairman. My name is Peter Gillespie, Managing Partner and co-founder of Technology Partners a specialized venture capital firm with offices in San Francisco and Chicago.

Our speciality is the financing of very early stage technology developments. I am pleased to have the opportunity to share with you our analysis of recent developments in the venture capital industry and governmental initiatives in support of technological innovation which in combination attracts us to this underserved segment of the market for risk capital.

I have spent the last seven years of my career as a Vice President of Heizer Corporation, one of the nation's leading venture capital firms. Prior to coming into the venture capital business, I spent five years working for Johnson and Johnson, a major health care products' company, with business planning and marketing responsibility. Early in my career I spent four years as a chemical process design engineer for Stone & Webster Engineering Corporation.

I

BACKGROUND

A. Objectives of Statement

First, I should like to voice support for President Reagan's economic program. The program in the aggregate constitutes a very positive step towards fundamental correction of the economic ills which beset the United States as we enter the decade of the 1980's. The specific provisions directed at providing a tax credit for increased corporate research and development expenditures and the proposed tax credit for corporate contributions to university research, will foster a rebuilding of our nation's pool of scientists and engineers and through them an increase in the rate of technological innovation.

Second, I would like to explain how tax advantaged Research and Development Limited Partnerships, which have recently begun to move capital to very early stage technology developments, can be used in conjunction with institutional venture capital to accelerate innovation. I recognize that this is not a tax writing body but would nevertheless like to focus Congressional attention on the need to permit the proposed 25% credit for increased Research and Development expenditure to flow through to investors of these R & D limited partnerships. This provision would provide comparable tax incentives for all new R & D expenditures and would not descriminate against the independently financed start-up venture.

Before presenting our analysis of why tax advantaged R & D limited partnerships represent an important new source of risk capital, I would like to briefly describe developments in the venture capital industry which result in a continuing shortage of capital for very early stage technology developments.

B. Venture Capital: A Developing Industry

The venture capital industry as we know it today is only 25-35 years old. American Research and Development was founded in 1946 and the Small Business Investment Act which was enacted in 1958 are recognized as the first steps in attracting a significant flow of capital to new enterprise development. Previously, most venture activity was conducted by wealthy individuals or wealthy families employing professional managers, i.e., Bessemer Securities, Rockefeller Brothers, J. H. Whitney & Co., Payson & Trask etc.

In addressing the shortage of capital for very early stage technology development, we believe it is important for government to understand the development of this new industry and its relationship to established business. Stan Pratt, publisher of the Venture Capital Journal, in conjunction with SRI International, estimates that the total pool of funds committed to venture capital investment is approximately $4.0 - $4.5 billion and that this pool has grown by about $1.5 billion since 1978.[1] These funds are managed by 400 to 500 venture capital firms and small business investment companies (SBIC's).

It is important to recognize that roughly 100 of the venture investment firms represented in these statistics employ 70-80% of the total capital commitment. The balance of the firms, primarily SBIC's, are involved in financing local businesses with limited revenue potential. The core group of firms which are the major factor in venture investing are financed by a variety of sources and operate over a wide range of investment activity, all of which falls under the venture capital label.

The core group is comprised first of the wealthy families who have maintained venture capital activities. The newcomers, comprised primarily of private partnerships and a few closely held corporations represent the largest number of firms and the bulk of the committed capital. These groups are funded by pension funds, insurance companies, university endowments and foundations, bank trust departments, major corporations, wealthy individuals and families, and more recently foreign investors. Also included in this group of active venture investors is a number of large SBIC's who are owned by banks or are subsidiaries of private venture capital partnerships.

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[1] SRI International, Guidelines Report #1053,"Identifying New Business Opportunities," Nov. 1980.

The venture capital industry has experienced severe growing pains during its early development. As a consequence, there have been several periods of shake-out in which less qualified and less committed firms dropped out of the business. Those who remained, gravitated to a niche in the venture investment spectrum which corresponded to their capabilities and perception of maximized return on resources invested.

Following the severe down turn in venture investing in the mid-1970's, the Venture Capital Journal published in February 1978 a two part study entitled,"Gaps in Capital Distribution-The Crisis For Business Development Financing." This report provides a good analysis of six venture investment categories where venture capital firms were concentrating their effort and where the greatest shortage of investment capital was felt.

Category A - Established businesses with moderate growth potential where investor returns can be significantly enhanced through the use of leveraging techniques.

- These investments involved primarily "leveraged buyouts of divisions or subsidiaries of large corporations and private family owned companies.
- The larger venture capital partnerships and bank venture capital groups participating heavily.
- There was no capital shortage in this area with the need for additional funds continuing to grow as the trend toward de-conglomeration spreads.

Category B - Established businesses with growth potential-principally those involved in technology development

- In 1978 this area was reported to represent the most serious capital gap.
- The absence of a viable public equity market for young companies with sales from $10 to $100 million was primarily responsible for the capital shortage. The relatively small size and difficulty involved in credit analysis of a technology company precluded long term funding from credit oriented institutional investors.

Category C - Rapidly growing businesses with sales volume between $1 million and $10 million

- The companies in this category have generally achieved initial profitability. There was no shortage of capital from venture capitalists and SBIC's in this area.

Category D - Young, small, profitable and viable companies that have not yet demonstrated a growth rate sufficient to attract venture capitalists

- This category represented a substantial capital gap. Venture capitalists are wary of "the living dead" and in some respects a company in this category is more difficult to finance than a start-up, where imagination is not fettered by previous experience.

Category E - Companies proceeding from the prototype stage to pre-production stage

- The study showed a substantial capital allocation problem for businesses in this category as well as a shortage of seekers due to the reduction in start-up activity nationwide.
- Entrepreneurs who are unable to prove out feasibilty using their own funding sources or if they do not believe capital is available at acceptable cost levels will often defer plans to start a new business

Category F - Start-up businesses which need seed capital to develop an idea into a feasible product or service.

- This is the area with the most recognized capital gap in the 1978 time frame. The study made two observations which are quoted in full because of their relevance to this hearing.

> " No discussion of start-up investments would be complete without reference to the problem of pure seed financings. These are generally high risk fundings to demonstrate the feasibility of [redacted] venture [redacted] for start-up financing. In addition, this would include the backing of marginal entrepreneurs, without an experienced track record, to achieve recognition of potential successful business development."

> " Since there is no organized activity in the seed capital segment currently, this does represent a significant capital gap. Individuals may provide some funding for this process, but there is a need to develop some capability within the organized venture capital community. This is of course, the highest risk segment and perhaps the most logical solution might involve

> the fully integrated venture capital organization allocating a very small percentage of their investments to this activity. *Or there may be a niche here for seed specialists who can work closely with organizations capable of providing follow-on capital after specific objectives have been met."* (Underlined emphasis added)

Before examining how funds have flowed back into the venture capital market since 1978 and how the capital shortages presented previously have been affected, it is useful to examine one piece of a study of the Venture Capital Investment, conducted by Dr. David J. Brophy, a member of the faculty of the Graduate School of Business, at the University of Michigan.

Professor Brophy surveyed new venture investments made during the period 1974-1979. His data was based on questionnaire responses from 55 of 72 experienced venture capital firms who are members of the National Venture Capital Association (NVCA). It is interesting to note that the year to year changes in the distribution of venture capital investment by stage of the company's development show very slight variation. His survey shows that between 1974 and 1979 start-ups represented roughly 25% to 30% of new investments and 20% to 25% of capital invested. His analysis suggests "that the effect of financial cycles may have a greater effect on the *volume* of new venture capital investment, than on its *distribution* by life-cycle of the recipient."

Professor Brophy's analysis also confirms the expected impact of the 1978 capital gains tax revision on the flow of venture capital gains tax revision on the flow of venture capital investment. The revision restored the differential between capital gains and ordinary income and as expected served to increase the flow of equity capital to venture capital investment.

The Venture Capital Journal statistics cited in the April 1981 issue of INC shows the magnitude of these new equity flows (when compared with the $10 million trickle which was recorded in 1975).

YEAR	PRIVATE V.C. FIRMS	TOTAL V. C. COMMITMENTS
1978	$216 million	$570 million
1979	$170 million	$319 million
1980	$657 million	$900 million

The figures provided under Total Venture Capital Commitments include SBIC's and Corporate venture capital subsidiaries.

Our review focuses on the fact that venture capital is a very young "industry." It has experienced, during the middle years of the seventies, severe capital shortages, with only about 25% of the capital of the most venturesome firms being directed at early stage start-up investments. The end of the decade and the first year of the eighties has seen a massive flow of institutional capital into professionally

TABLE I

CLASSIFICATION OF NEW VENTURE CAPITAL INVESTMENTS BY [redacted] OF FINANCING

	1979		1978		1977	
	# OF INVESTMENTS	$ INVESTED (000 Omitted)	# OF INVESTMENTS	$ INVE[redacted]	# OF INVESTMENTS	$ INVESTED
Start-up	64 (22.3%)	$26,553 (18.5%)	67 (34.2%)	$20,403 [redacted]	39 (31.0%)	$14,556 (25.9%)
1st Round Financing	103 (35.9%)	47,696 (33.3%)	79 (40.3%)	32,576 [redacted]	57 (45.2%)	25,042 (44.6%)
2nd Round Financing	120 (41.8%)	69,005 (48.2%)	38 (19.4%)	34,991 [redacted]	26 (20.6%)	14,203 (25.3%)
Other	0 0	0 0	1 (.5%)	90 [redacted]	3 (2.4%)	2,209 (3.9%)
Unclassified	0 0	0 0	11 (5.6%)	3,775 [redacted]	1 (.8%)	200 (.3%)
TOTAL	287 (100.0%)	$143,254 (100.0%)	196 (100.0%)	$91,835 ([redacted])	126 (100.0%)	$56,210 (100.0%)

	1976		197[redacted]		1974	
	# OF INVESTMENTS	$ INVESTED (000 Omitted)	# OF INVESTMENTS	$ INVE[redacted] (000 O[redacted])	# OF INVESTMENTS	$ INVESTED (000 Omitted)
Start-up	26 (26.8%)	$ 9,113 (24.9%)	18 (29.0%)	6,239 [redacted]	18 (23.4%)	$ 5,175 (16.1%)
1st Round Financing	29 (29.9%)	11,700 (32.0%)	10 (16.1%)	1,242 [redacted]	27 (35.1%)	14,940 (46.5%)
2nd Round Financing	33 (34.0%)	13,526 (37.0%)	21 (33.9%)	7,079 [redacted]	23 (29.9%)	9,429 (29.3%)
Other	6 (6.2%)	1,189 (3.3%)	7 (11.3%)	2,195 (10.5%)	4 (5.2%)	700 (2.2%)
Unclassified	3 (3.1%)	1,028 (2.8%)	6 (9.7%)	2,145 (10.3%)	5 (6.4%)	1,906 (5.9%)
TOTAL	97 (100.0%)	$36,556 (100.0%)	62 (100.0%)	$20,900 (100.0%)	77 (100.0%)	$32,150 (100.0%)

managed venture capital firms. In the next section, we will seek to appraise how much of this new wave of venture capital is likely to move into start-up and seed capital investments.

C. Start-Up And Seed Capital Shortages in a Booming Venture Capital Market

The capital committed to venture capital is at an all time high. The $657 million of new funds committed to venture capital in 1980, if Professor Brophy's 20-25% historical average holds up, should produce between $130 million and $165 million of new start-up capital. Is capital moving into startups at that rate? How much of those funds will be devoted to true seed capital situations?

One has only to review recent investment activity in the genetic engineering field to see significant start-up and seed capital investments on the part of a select group of professional venture capitalists. [illegible] activity in the more traditional electronics related industries reveals a substantially expanded level of start-up activity from the levels which prevailed in the seventies.

It will be several years before a reliable study of the distribution pattern of more recent investment activity is available. As in the past we are not likely to satisfied by the data which will be available to characterize supply and demand of seed capital. In spite of the inherent difficulty of making preliminary judgments on how well the venture capital industry is addressing start-up and seed capital needs in the economy, some reliable indications can be developed.

Our analysis suggests that although the venture capital industry has stepped up its start-up investment activity, recent structural changes in the industry will limit its ability to meet the demand for start-up financing and leave unserved much of the seed capital requirement. The basis for this anticipated shortage is first, a strong increase in the demand for start-up capital and secondly, a near term shortage of skilled venture capitalists. A more subtle but significant impediment which underlies these developments is the inherent difficulty and risk associated with making and managing early stage start-up investments. Our analysis which explains these conslusions is set out in the following points:

1. The Increased Demand for Seed and Start-Up Capital

Entrepreneurial activity is closely tied to the availability of venture capital. When venture capital virtually dried up in 1975, entrepreneurial business starts were at an all time low. The superior performance of venture capital firms in the seventies coupled with supportive public policy moves, and recognition of our nation's declining productivity served to awaken the new enterprise sector and heightened investor interest in venture capital in the last two years.

Increased venture capital activity coupled with a greatly improved public stock market are very supportive forces for people considering new business starts. Another indication of the increased interest in entrepreneurship is the success which new magazines such as Venture and Inc. have had in addressing this issue. More importantly these publications are making it easier for would be entrepreneurs to understand the venture capital financing process and also provide specific assistance on how to locate venture capital.

A final and potentially long term spur to sustaining the recent expansion of entrepreneurial activity should result from passage of President Reagan's economic package. The R & D tax incentive and a tax break for university sponsored research should greatly accelerate scientific discovery and invention. This activity in big business is essential to fostering an expansion of new business as well as outside it, in the new enterprise sector.

2. The Realities of Start-Up Investing - A Major Deterrent

Much has been written on the subject of invention, innovation and new business financing. Henry Riggs, writing in the Stanford Engineer presents a very lucid discussion of the key issues underlying successful development of technology. He explains at length the important distinction between invention and innovation and presents his thesis as to why smaller, technology-based companies are much more successful innovators than mature companies. He also discusses the difference between marginal vs high potential ventures in terms of their ability to impact the economy and create jobs.

I would like to quote his definition of high potential technology ventures, "Those new companies that by virtue of their business definition, staffing and their financing are geared to becoming major business enterprises." I trust these kinds of companies are the ones we are seeking to foster. He goes on to say that, "The entrepreneurs in such ventures have classic business objectives, growth and financial returns, and seek to exploit a significant product or market opportunity."

I have underlined five terms above which spell out much of the difficulty a venture capitalist faces in considering a raw start-up. First, he must assess the technological risk embodied in the new enterprise's ability to make the product or service work. The closer the enterprise is to the scientific

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[2] Henry E. Riggs, The Stanford Engineer, "The Case For Technology Entrepreneurs," Spring/Summer 1980.

frontier" the greater the technological risk and the more effort required on the part of venture capitalist to make sound evaluation. Projects in this category have greater difficulty moving through a venture capitalist screen than the next generation of computer hardware which clearly is further back from the scientific frontier.

Successful venture investing requires exceptional people skills to accurately assess the capabilities of the entrepreneur and the managers in key staff positions. Where there are gaps, the venture capitalist is somethimes forced to act as an interim President or at a minimum to be in a position to help recruit highly qualified staff.

Lastly, he must have well developed skills to assist in the early business and financial planning effort especially as the venture moves closer to the seed capital end of the spectrum.

The Charpie Report, prepared for the Department of Commerce, which was another extremely well researched study of the barriers to technological innovation, made one particularly telling observation with respect to the issues described above.[3] The attention they devoted to this subject resulted in labelling it the "appraisal gap." The report cited that sources of capital very seldom have technical backgrounds to cope with the complex technology-based ventures. They are asked to evaluate, and only rarely have staffs which can help materially in these appraisals.

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[3] Robert A. Charpie, Chairman, Panel On Invention and Innovation, U. S. Department of Commerce, Technological Innovation: It Environment and Management, January 1967.

Since 1967, venture firms, especially those operating on the start-up end of the spectrum, have upgraded their assessment capabilities. However, when one considers the variety of new technologies which a venture capitalist encounters, the Charpie Report's comment that "there truly are very few capital sources who understand equally well the nuances of convertible debentures and the intricacies of gas laser technology," still has considerable relevance today.

The next point demonstrates how the venture capital industry development, while very healthy, is not keeping pace with a rapidly expanding demand for new start-up capital.

3. The continuing shortage of start-up venture capitalists

Previous discussion pointed out that the venture capital industry is still very young. Industry data also presented indicated that there were only one hundred firms operating in 1978 and making investments across the broad range of Categories we discussed. In a telephone conversation with Stanley Pratt, publisher of the Venture Capital Journal, he indicated that approximately 25 new private venture capital firms have been added to the industry roster since 1978. These firms typically employ two or three experienced investors and frequently a like number of new people to the business.

It is important to recognize that virtually all of these firms were spin-offs from the 100 firms who made it through the severe market downturn of the mid-seventies. A 25% expansion in the number of firms is a good record considering the stringent demands of this class of investing, and the small staffs which venture capital partnerships by necessity, employ. Virtually all of the currently operating venture firms have increased their staffs in recent years. Consequently, it is reasonable to expect that a much larger group of fledgling venture capitalists is currently in training.

Venture magazine in July 1981, published a listing of the capital raised by the top 25 independent venture capital firms. In [illegible] typically averaged around [illegible] million. T. A. Associates of Boston leads the list with $105 million of capital under management and the 10th largest firm, has a capitalization of $53 million. The problem this data reveals is simply that the flow of funds into the venture capital field is growing much faster than the number of qualified venture capitalists to manage it.

That completes the third and final point in our analysis of the factors we cite supporting the contention that capital for very early stage technology projects is likely to stay in short supply. We started by describing the factors which indicate a very strong increase in the supply of new entrepreneurs seeking capital. Next we stepped back to look at the realities of venture investing and hopefully convinced you that a major constraint these entrepreneurs face is the immense difficulty capital sources have in contending with the technological complexity which this growing demand provides. Lastly we looked at the Venture Capital industry to observe that the supply of experienced venture capitalists is not growing as fast as the funds which are seeking to be placed.

These, in my judgment, are the classic problems of growth and economic change in a complex technological society. The venture [illegible] as we can expect to keep up with the increased entrepreneurial demand. It has the pleasant problem of capital abundance rather than scarcity to deal with. We feel that these funds will be intelligently placed and that they will contribute significantly to improving our nation's industrial productivity.

A hard look at these developments suggests very clearly that as venture capitalists seek to place the capital they are managing, they will be pressed to move away from time intensive, low capital, consuming early stage ventures to larger projects which will put more capital to work.

Following this logic, we anticipate that venture capitalists who are comfortable with start-ups will continue to do them but they will, by necessity, continue to be very selective in the kinds of "deals" they do.

The scenario we see developing is one in which funding will continue to be available for lower technological risk projects which are not bumping up against the scientific frontier. These innovative developments will be most readily done when they are initiated by high quality entrepreneurs, ie., people who have done a previous start-up or well balanced teams with strong track records in the technologies and industries they are [illegible].

The individual least likely to make it through the venture [illegible] an incomplete business plan and/or management team. He/She will face even more difficulty if the venture they are seeking to launch bumps up against the scientific frontier or is directed at technologies and industries which stretch the prior experience of the venture capitalists they contact.

These are precisely the kinds of people this Committee is seeking to assist in insuring that financial resources be made available on a sensible basis. Let us move on to discuss the Research and Development Limited partnership and why we believe it can contribute significantly to expanding the flow of seed and start-up capital, to worthy projects which would not otherwise be funded by the venture capital industry.

II

THE RESEARCH AND DEVELOPMENT LIMITED PARTNERSHIP

The shortage of seed capital was recognized in Category F of Stan Pratt's 1978 analysis of venture capital investment activity. He concluded his comments by proposing a possible solution which we feel is likely to emerge as an important answer to this area of capital scarcity. Mr. Pratt suggested (and again we add underlining for emphasis) a possible role for "seed [illegible] can work closely with organizations capa[illegible] specific objectives have been met."

We concur that this is precisely what is needed. Furthermore, we concluded that the emergence of R & D partnership financing brings a potentially large supply of funding for worthy projects that could well go unfunded in today's constrained venture capital market.

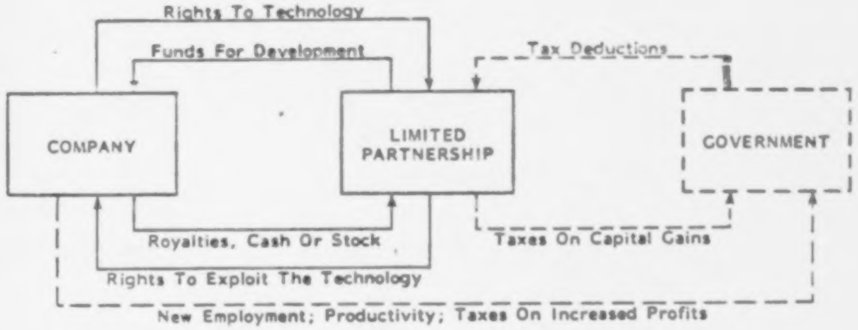
We will start by briefly explaining the key interrelationships which establish this approach as a viable source of considerable new and start-up capital. We will explain how this device is likely to attract the new layer of seed capital specialists.

From our perspective, the required governmental actions have already been initiated, except for consistent application of the proposed R & D tax credit to start-up ventures as well as established businesses. We will close with a plea for understanding of the true risk sharing nature of the R & D partnership format and caution that these principles not be forgotten when inevitably governmental forces antagonistic to "tax shelters" seek to regulate its use. Let me move on to establish the origin of this financing device and describe how it operates.

Research and Development Limited partnerships were virtually unheard of until 1978 when Lear Corporation use one to finance a [illegible] used one in the development of [illegible] new automobile design. Interest in this form of financing spread as a result of two recent large R & D financings which were widely publicized. Storage Technology used one to raise $50 million to develop a new mainframe computer and Gene Amdahl used one to raise half of the $100 million financing required to launch his new large computer venture, Trilogy Systems Inc.

The schematic presented below outlines the key interrelationships between the three primary risk sharing entities in the development of new technology using this approach.

R&D PARTNERSHIP CONCEPT


Rights To Technology
Funds For Development
Tax Deductions
COMPANY
LIMITED PARTNERSHIP
GOVERNMENT
Royalties, Cash Or Stock
Taxes On Capital Gains
Rights To Exploit The Technology
New Employment; Productivity; Taxes On Increased Profits

The seeds for this approach were sown through legislative intent in drafting Section 174 of the tax code. Congressional purpose was stated as being "...to equalize the tax benefits of the on-going [illegible] and about to reach market...(and)...to encourage expenditure for research and experimentation." The use of Section 174 for new venture financing was opposed by the IRS and it was not until the 1974 Supreme Court decision in the SNOW case that the way was clear to use it to fulfil the Congressional intent. It took from 1974 until about 1978 for the financial community to recognize the R & D partnership as a legitimate source of risk capital for both new and established companies.

We believe the research and development limited partnership, applied to sound business opportunity represents a fair and attractive allocation of risks and potential rewards. Since the entrepreneur, using the classis R & D partnership does not have to give up any equity in return for high risk product development financing, he is able to minimize the share of ownership which he normally would have to give up if conventional venture capital financing were employed.

The limited partners, in return for their risk capital, are offered near-term tax deductions and the potential for attractive after-tax returns. Government foregoes current tax revenue in order to stimulate technological innovation in the private sector, which ultimately should yield improved productivity, ne[illegible] increased taxable corporate profits.

Because of the clarified government intent, the blessing of the financial community, and the existence of an unfilled demand among high-tax bracket individuals for well structured venture capital investments which offer both tax advantages and the potential for substantial capital appreciation, this financing approach is beginning to be much more widely used in facilitating the formation of new technology-based ventures as well as in support of capital constrained Research and Development in the established company.

Why haven't such seed capital specialists emerged within the venture capital community and why are they likely to be established to implement R & D partnership financings? The short answer to the first part of that question goes to the source of most professional venture capital. Most of it is from fiduciaries who would have great difficulty directing funds to an activity directed solely to the high risk end of the venture capital spectrum.

Seed capital specialists face the same kind of overhead costs a venture capital firm must contend with and here to fore, it was not feasible to attract private long term equity capital to support ferreting out and evaluating attractive investment opport[illegible]

Why are we comfortable that the R & D partnership will overcome these limitations. Our answer lies in the experience gained using similar financing in real estate investment and oil and gas exploration. Because the pool of individual wealth is so large, competent, professionally managed firms, have emerged in both areas. The structure of the partnerships are such that the general partners who find, evaluate, structure, and work with these projects over time, are able to obtain adequate compensation to cover operating expenses. Futhermore, they have been able to obtain a substantial incentive stake in the long term success of the project to attract very competent people. We are confident that the R & D partnership for new technology will develop in a very similar fashion.

It is very important to focus on the source of investment capital for R & D partnerships, to draw comfort that it is not likely to be subject to impropriety. SEC restrictions on the private placement of such offerings require that they be limited to very high tax bracket individuals with considerable discretionary income. We envision that these R & D limited partnership interests will be a market for senior corporate executives who have the capacity to judge the economic soundness of the proposed venture. For the most part, they will be committing considerable capital on a deal by deal basis. This requirement forces scrutiny of each and every investment rather than a one [illegible] which promises enormous tax savings and substantial capital appreciation.

It is our contention that current IRS and SEC regulations deal very effectively with the key issues underlying the solicitation of these financings and the accounting practices which must be followed during the life of the partnership. The only major impediment to the spread of firms seeking to fund worthy seed and start-up capital projects in this manner, is the potential for change, increased complexity, or uneven regulation of R & D partnerships.

The utility of this new tier in the venture capital spectrum is further enhanced when one recognizes that only 70% to 80% of a start-up technology venture can be covered by tax advantaged R & D partnership capital. There is a continuing need for small amounts of seed equity to be placed in conjunction with the limited partnership financing. There is evidence already developing that the established venture capital firms will be attracted to working with qualified seed capital specialists to launch these new ventures.

Finally, we would like to take this opportunity to argue that the proposed R & D tax credit be permitted to flow through to the investors in private technology ventures using the R & D limited partnership vehicle. Not to do so would discriminate in favor of the large company and against independent technology start-up [illegible] recognized as the most productive avenues for significant innovation.

Mr. **Gore**. Thank you very much.

Mr. Vollers, welcome.

[The biographical sketch of Mr. Vollers follows:]

PETER VOLLERS

President and co-founder of International Technology Resources, Inc. (ITR), a New York corporation. Principal activities include: US technology search responsibilities for various clients including the Swedish Ministry of Industry, Establishment Commission, in their program to assist small, limited resource companies to identify expansion opportunities. Co-developed the License Planning Model, a computerized financial analysis model used to assist in rationalization of price-setting in technology transfers. Developed an analytical model of a $37 million oil and gas tax shelter.

Was previously employed by Cummins Engine Company of Columbus, Indiana as an Industrial and Marine Planning Analyst with responsibility for developing worldwide marketing strategies, emphasis programs and pricing strategies. Also, employed as Audit Manager/Distributor Operations with responsibilities for creation, planning and coordination of service audits of Cummins' system of distributors in the US and Canada.

Received B.S. Degree in International Marketing from Northern Illinois University and an M.B.A. in International Finance from Columbia University Graduate School of Business. Also attended Edinburgh College of Commerce in Edinburgh, Scotland. Member of the Licensing Executives Society, American Association of Small Research Companies, guest lecturer at the American Management Association seminars on Licensing and New Product Development and the Federal Briefing Conferences for small, technology-based firms.

Mr. **Vollers**. Good afternoon, gentlemen. I would like to introduce myself and give you some background. My company is International Technology Resources. We are a New York corporation. We deal in new venture search, evaluation and promotion in particularly the technology transfer area. We started in 1978. We came out of Columbia University, out of a new ventures course taught by a very stimulating professor, Ian McMillan. There was myself and my partner, Bruce Marquart, who started the company. We had observed that the whole aspect of innovation was going to be an emerging issue in the 1980's and even more so technology transfer, and we decided to position ourselves so that we could participate in that activity.

We started our company with capitalization of $20,000 in loans, which we have had to pay back. We also had a couple of short-term contracts with some clients, large corporations, one of them being a Swedish Government company. In that initial period, we developed computerized models specifically for the valuation issues that are associated with licensing. Currently, we have clients on time share, microcomputer models that we installed and are on site, and we write opinions on licensing valuations.

We have performed these activities in the hopes of developing a bread and butter business so that we could eventually move into the new product development areas. We are currently moving into that field and have a private offering memorandum in press to raise money for the purpose of prototype development funding.

In terms of the issue of difficulties in obtaining initial funding and the search for these funds, we perceive this to be largely a problem of infrastructure and support services. From the hearings that I have listened to this morning, there are some significant activities that are being undertaken to improve this situation. More improvements can be made. There are educational needs of the inventor himself that, in our experience of giving seminars and working with these individuals, could be improved upon.

We have noticed that the average innovator that we have come across can't differentiate between the options available to him, whether he might pursue licensing or whether he might pursue venture capital or some other form of financing. He has difficulty in packaging proposals. He oftentimes does not have the money to show that what he does have actually works. And, in many cases, he has simply too high expectations in order to arrive at an agreeable range within the negotiating limits that can be perceived.

In our pricing evaluation, we have constructed models which essentially identify how we perceive the negotiating range. If I might suggest that in a licensing situation, you would begin with a minimum acceptable price that an individual would require in order to be encouraged to enter into a negotiation. Then, this would go as high as a commercialization value of an innovation. So that if I were selling a technology to a company and it would be evident that the company might be stimulated by a 40 percent return on investment, this would have an actual value in terms of royalty income, a 10 percent royalty, for instance, over a certain lifetime, yielding a certain amount of money. This would be the commercialization value.

As you proceed along the continuum from concept to commercialization, you progressively move up this scale from a minimum acceptable price to a commercialized value. Oftentimes, we have seen with innovators that we have worked with that they gage an expectation of the value of their technology based on a fully commercialized product when in actuality it is a piece of paper on which they have spent $5,000 and waited 2 years to get a patent clearance. This is not sufficient to bring the inventor within the *negotiating range. Because he doesn't recognize the changing* values along the continuum.

In order to obtain seed capital, there are various approaches that might be pursued. Venture capital is difficult to obtain largely because they requirement that there is a management team that is intact, a market that ia verified and a production prototype that must be demonstrable.

Other alternatives might be private or wealthy individuals that can provide that initial funding. Peter Gillespie gave some excellent insights into the tax shelters that I feel are going to be an emerging source for seed capital funding.

The other alternative—where we have had most of our experience to this point in time—is licensing. Difficulties we have encountered besides the shortcomings of the innovators themselves is the patent validity problems that have been demonstrated in a number of different studies.

The Judiciary Committee of the House as I understand it is currently investigating patent law and the problems that are associated with it. This patent validity problem is compounded by something that is called the least-cost alternative.

In this range that we were talking about of a minimum acceptable price and a commercialized value, there is something that causes pressure to push down on the value of technology and this is called the least cost alternative. According to John Pfanstiel of the Inventors Club of America, the average cost for defending a patent validity suit is about $250,000. These are considerable resources to be brought to bear by an innovator.

But more so what it demonstrates is that there is a least-cost alternative of $250,000, or perhaps it is $500,000 or $800,000, that might be pursued by a licensee as an alternative to a settlement with an innovator. Essentially the least cost alternatives available to a licensee are to acquire comparable technology, to design around an innovation, to invent it themselves or to openly violate.

Depending on the scruples of that corporation, they may choose any one of those options in commercializing an innovation. And legal suits have been taking 12 years, 20 years, in order to go through the judicial system. Now this also causes some additional problems if instead of just outright infringing a patent, a licensee might purchase a patent and then decide to stop making payments and contest the validity after that, in which case the patent would be tied up in court.

The licensee can continue making that product during time that it is tied up in litigation. And the inventor or the innovator has virtually no recourse in order to be able to rectify that situation. So that is a definite perceived problem by innovators.

We have some inventors as clients right now who are just afraid to death of sharing information with prospective licensees because of the amount of information that they are required to submit in order to be able to allow the licensee to evaluate the technology that they have.

Various disclosure agreements are required by the licensees which essentially open up the entire book of the inventor. The inventor has difficulty in distinguishing where to draw the line between what proprietary information he needs to keep in order to prevent the licensee from circumventing what he is doing and proceed on one of these least cost alternatives such as designing around what the inventor has.

In addition to these patent validity problems, there are also the problems of qualified assistance in marketing an innovation. Technical facility support is needed as well, but particularly the marketing of innovations is a problem. There is a lot of nuisance money around that is chasing after the inventors with good ideas, but inventors have.

I was recently giving some seminars at the Federal briefings for small, high technology companies in Washington and in Detroit. Some of the innovators who were there found themselves inundated when they returned with insignificant offers to take over a majority ownership of their technologies. These came with all sorts of strings attached. The inventor needs assistance to screen quick buck artists.

This all adds to the problem of the limited resource innovator. He has difficulty as it is in distinguishing between options. And then when he is pressured with a myriad of different options which he doesn't necessary perceive as opportunities, this further complicates the problem and he becomes very inert in how to deal with these situations.

On the issue of infrastructure, I would like to share some experience I have had with working with the Swedish Government and some of their activities in trying to assist the limited resource innovator. The Swedish Government started a program some 3 years ago which was called a development fund. What this basically consisted of was developing some 12 different development regions in the country and then supplying resources, both manpower and financial resources, to these development funds to assist limited resource companies.

The way the system basically worked was that the limited resource company as it is qualified according to certain criteria, would obtain funding assistance to identify opportunities that he might license in from other companies, or obtain assistance to develop that deal packaging that he needs.

In order to make an opportunity materialize, you have to be able to professionally communicate what it is. So often, you are stretching the capabilities of an inventor by requiring him to be a company president and inventor and accountant and lawyer and five other different functions. He needs some support services to make a deal happen.

But basically to continue with the Swedish example, the development funds provide subsidy to the limited resource innovator or small research company to acquire and/or sell their technology. In addition, should they identify opportunities that they might wish to license in funding would be provided in the form of a grant if the innovation failed. If the subsequent venture proved a success, then the moneys would be required to be paid with some manner of interest payment attached to it. I am not suggesting that this is necessarily the most attractive or appropriate way to go in the United States, but what I am suggesting is that this does provide an infrastructure for the innovator so that he has a resource that he can go to. Programs such as the innovation centers at the universities, for example, Mr. Mittelstaedt and the Wharton school, are providing some of these infrastructure and support service needs. There is much more that should and could be done for these innovators.

Finally, drawing from my exposures in giving regular seminars, when I have 200 innovators and small research company presidents sitting in a room and I present an analysis of evaluating a technology and how much is its relative worth in the market and they come to me afterward and they ask about very mundane issues dealing with how to set up cash flow statements and things of that nature, it points to a very basic problem and that is a simple matter of business education.

Educational materials are needed in a cookbook fashion providing how-to approaches, that are very easily constructed and easily written so that the layman can help himself to proceed to commercialize his innovations and to raise the funding necessary.

These are the suggestions that I would like to submit.

[The prepared statement of Mr. Vollers follows:]

Peter Vollers July 1981

INITIAL DEVELOPMENT FUNDING

I have been asked to share some of my observations on this stage of the commercialization process. I will address two issues before this subcommittee:

1) What are some of the difficulties encountered by limited resource innovators in seeking initial development funding?
2) What alternative approaches, such as licensing, are available to the independent inventor and small research company?

I am pleased to have an opportunity to communicate my feelings on these matters. I will begin with observations dealing with difficulties in fundseeking.

The principal bottleneck in the innovation process today occurs at the prototype development stage. Specifically, for the individual inventor and small research company, it is attracting sufficient seed capital at this stage to test and demonstrate the claims of his/her technology that is contributing to the slowdown.

In many cases the technology is patented, but is not yet a commercial reality. This is a particularly difficult period because the burden of proof of technical and economic viability rests with these generally under-capitalized innovators. As I hope to point out, there are financial, managerial and environmental limitations--each of which contribute to this bottleneck.

An insight into the difficulties can be obtained by examining the basic needs of the fundseeker and the rundraiser.

In order for the fundseeker to obtain the necessary monies to accomplish his/her goals, he/she must be an individual of many talents. It is not raw intelligence that distinguishes the inventor/entrepreneur, it is also perseverance and determination, ability to think in a free-associative manner, be a risk-taker and long-range thinker in a society that is getting more security-minded and consumption-oriented by the year, have the contacts, or more often family and friends, who will contribute to sustaining the effort in its embryonic stage, and a little bit of luck.

The fundseeker often has expectations that upon consummation of the invention, s/he need only explain the merits of the innovation to a capitalist-minded individual, owning or having access to substantial means, and commercialization will follow. But this is obviously not the case. The prototype funding bottleneck enters the picture.

In order for the fundraiser to be motivated to support a given innovation, s/he must feel strongly about the commercial possibilities of such innovation that receives his/her endorsement, because the fundraiser/venture capitalist is fully anticipating the need to make significant additional investment should the resulting venture achieve rapid growth.

From the venture investor point of view, both technical and business skills are sought. An old adage bandied about in the venture capital circles (I believe attributable to G. Doriot of the first venture capital firm American Research and Development) goes as follows: "I'd rather have an 'A' man and a 'B' product than a 'B' man and an 'A' product." It frequently comes down to this trade-off in the initial screening that results in the dismissal of a business opportunity. This is not meant to detract from the technical genious of the innovator. It rather suggests that the innovator is lacking in the business skills himself, or has not developed the relationships with business partners and/or advisors that can clearly define the options and prerequisites necessary to present a viable plan for commercialization/exploitation of the innovation. Enough, atleast, to satisfy the needs of the venture capitalist to move money or to convey a strong likelihood of success.

Some firms which were actively involved in new product deveopment in the past have consciously moved away from sponsoring this activity due to the larger risks involved in this type of business development. As a fundraising firm grows in its responsibilities to manage money, it begins to exclude smaller, high risk business developments in favor of larger and more fully developed business concepts. The issues involve both the matter of time required to competently oversee the activities of a given number of ventures and the matter of portfolio of investments that will diversify the risk of the venture manager.

Assume that a venture fund is staffed by three persons and that the size of the fund is $15 million. Each manager may, in an average situation, assume responsibility for three ventures in addition to searching for new opportunities, at any one time. As most any venture manager will attest, significant follow-on funding is required in those companies that achieve high growth status. The effects of this are that more money is directed to the highest growth prospects and not to large numbers of concept verification testing. Keeping control over a large number of prototype and product testing projects is much more difficult than closely directing opportunities in 2 or 3 ventures. Also, it is not in the venture capitalists interest to allocate too much of the fund to the prototype development stage, because this is the highest risk stage in the business development process. Uncertainties are magnified and the time required to achieve commercialization is extended. It is generally desirable to diversify this risk by allocating a significant portion of the fund to opportunities that are farther along the road to success.

Should the independent innovator not have the diverse capabilities and business skills mentioned previously, at least in the eyes of the venture manager, no business will be conducted. Recent attempts by this writer to approach venture capitalists with an innovation in the medical field produced a generally universal reply. The venture capitalists' response was, "Bring me three things, and we can have some serious discussions: 1) a verification of the market, 2) a management team intact, 3) a working prototype." The bottleneck again makes its appearance.

Road to a Bottleneck

The rationale for investing in prototype development can be more fully understood by examining the innovation process. The Innovation Process has several market and environmental factors that are essential if it is to flourish. Some of these factors include:

1) A social ideology that is essentially pragmatic, curious, and appreciative of "new inventions", science, and material values.
2) Easy access to information about the latest advances worldwide in pure scientific research and applied science.
3) Large, diversified markets.
4) A strong patent system to grant temporary monopolies to innovators.
5) A cultural and political environment that encourages and rewards personal and capitalist risk-taking.
6) Most importantly, entrepreneurial management and investors who can and are willing to take substantial risks in return for high rewards.

It is my contention that Items 4, 5 and 6 above are each significant contributors to this bottleneck. In addition, there are the financial realities of limited resource innovators, the portfolio investment requirements of the venture capitalists, and the human limitations of each of these persons to store, process and retrieve information and then to make prudent decisions from such information. Let us begin by considering Factor 6 above.

Offtimes an inventor attempts to assume the role of the entrepreneur only to realize that the free associative thinking that came so easily in the laboratory or workshop comes to a grinding halt at the conference table. A good inventor does not in general make a good entrepreneur. Sociologists have analyzed the behavior of the innovator and have often found personality traits that challenge convention. The risk aversion of the salaried individual is offtimes not compatible with and generally unwilling to indulge the ideosyncracies of independents.

According to the Inventors Club of America, studies have characterized the personality traits of creative individuals with the following generalities: "independence of judgment in thought and action, unconventional, honest, abrupt, impulsive, risk-taking, less bound by arbitrary social conventions, authority and current economic status." These traits do not necessarily bode well for relationship building with large corporations. Equally so, venture capitalists and other fundraisers are reluctant to champion the cause of many inventors not necessarily do to personality traits, but rather do to lack of business acumen. Venture capitalists are willing to take substantial risks, but only when it is in their best interests to do so and when the major factors contributing to uncertainty in the success of a venture have been adequately dealt with--namely, marketability, technical feasibility and management prowess.

Considering Number 5 above, it is strongly felt by this writer that the cultural and political environment that encourages and rewards personal and capitalist risk-taking is not running in the US today.

Culturally, society is becoming more risk averse. From an educational viewpoint, the faculty and placement personnel for graduates in Business Administration and Engineering emphasize the middle management slot in large corporations as a target direction to pursue.

From the perspective of political environment, it is not evident that the tax system is working as well as it should. If the policymakers wanted to create hightened innovative activity it could do so by applying tax uniformity and relief to encourage such activity to ensue.

Consider real estate as an investment alternative to innovation funding. Here is a much more secure investment vehicle in comparison to R & D investment. Cash flows and terminal values of income-producing properties are much more predictable than trying to demonstrate a new product concept. Yet at-risk provisions do not apply to real estate, whereas they do apply to innovation finance. The use of nonrecourse notes as an R & D tax shelter financing tool was eliminated in the Revenue Act of 1978. The National Venture Capital Association has long been pressing for other reforms that are needed.

When considering alternative investments, one should not overlook risk-free securities. When risk-free investments such as T-bills yield 16½% and the prime rate is at 20½% and when one considers that the performance of the better venture funds offer returns of 25% and the moderate funds yield something less and they keep your investment capital tied up for 10 years, is this really an environment that encourages personal and capitalist risk-taking? I think not.

Studies by the National Venture Capital Association and others show clearly that innovation is a major job contributor and revenue contributor from the IRS standpoint. The issues seem so clear, yet policymakers have not been successful in providing preferred treatments to innovation research.

One of the largest deterrents is Factor 4, a strong patent system to grant temporary monopolies to innovators. The failings here are monstrous. Not only does a weak patent protection system discourage innovation funding to take place, it also suppresses a great many patents that might otherwise have emerged.

Two major issues deserve attention -- invalidation and obviousness.

1) Independent inventors cannot uphold their patent rights in US courts, so why bother?

If you are an independent inventor and want to stop a large firm from infringing upon your patent, that large firm will in all likelihood contest the validity of the patent in court. How many inventors are prepared to assume the current average legal defense costs of $250,000? Consider further that the infringer can continue to make and sell the product while the validity suit ties up the patent for 12 to 20 years. Consider also that only 15% of contested patents are upheld in our court system. Compare this with 85% upheld in countries like Germany and Japan and Great Britain. As pointed out by Irving S. Shapiro, Chairman of du Pont, as reported by Industrial Research/Development,

> "The judicial attitude, which 'reflects the public will' tends to work against these people and organizations with new ideas and the willingness to take the risks of putting them into the marketplace." (The reason that other countries uphold their patents more often is not a result of) 'more wisely' courts or 'better patent examining procedures'. (It is because) 'the climate in those countries for innovation is less threatened by hostile judicial attitudes. Those who found research know with a high degree of certainty that if they strike new technology, it's theirs, and cannot be taken from them easily.

2) Many new product patents are killed by the obviousness clause.

To cover this issue, I would like to quote Mr. John Pfansteihl, Executive Director of the Inventors Club of America.

> "Patent applications are too often denied because a Patent and Trademark Office (PTO) examiner feels the invention would be too obvious to one skilled in the art. Obviousness is loosely defined and subjectively applied by each examiner. All too often an improvement, or a new combination, or a new application looks obvious once it is shown. The wheel and axle were used as toys for centuries before civilizations thought to use them in transportation. People are much less likely to proceed with development and production of new products if the time and money they risk won't be protected by a patent."

Certainly you don't want to create a situation where infringements are further encouraged by allowing meaningless claims to supercede a prior basic patent; however, some need for redefinition of obviousness should be made. Currently 20.4% of patent invalidations are due to obviousness.

According to Mr. Pfansteihl, some circuit courts such as the Ninth Circuit Court of Appeals serving California, Idaho, Arizona, Montana, Nevada, Oregon, Washington, Alaska, Hawaii and Guam are particularly active in denying patent validity. Upon appeal validity is upheld in less than 30% of the cases. The Ninth Circuit apparently has the distinction of virtual certainty of invalidation resulting. (For an excellent discussion of this issue, see "The Crisis of Law in Patents" by Irving Kayton, J.S.D. Also, the House Judiciary Committee is currently investigating issues related to shortcomings in the patent system.)

There is a correlary issue dealing with both funding and innovation activity itself that is affected by these legal issues--namely, the stagnant level of patent issuance for more than a decade.

I would like to hazard an interpretation of the relatively level, or perhaps slightly declining, absolute number of patents granted and the relative percentages of corporate to independent patents granted. (There are something over 200 patents issued, on the average, daily, of which about 30 are issued to independents. This relationship has maintained itself since before 1970.)

Concerning the ratio of independent inventor to corporate patent owners, independents have been getting about 15% of patents issued and corporations about 85%. There are few incentives to this segment to step up innovation for reasons--not the least of which include legal system deficiencies mentioned earlier. Lack of an infrastructure to provide business guidance to independents is another contributing factor.

Concerning the corporate and independent inventor, stagnant patent and funding activity can also be attributed to several other causes.

1) According to the New York Times Magazine, 1980 federal and private spending on research and development amounted to about $60.4 billion. When the affects of inflation have been considered, only a slight real dollar increase has been noted since 1971. If federal and private spending do not increase, it is difficult to expect patent and funding activity to increase overall.

2) We have a patent system that takes about two years to clear from date of application to granting. Theoretically a 17-year monopoly to exploit such invention is awarded thereafter. But it has also been claimed that half of all new products are obsolete within five years, with obsolescence in various computer hardware and software support fields occurring in periods of two years or less. The late sixties brought on a myriad of emerging short-life cycle technologies that flourished in the seventies. Given such innovation rate changes, it hardly makes sense to patent certain developments.

3) Finally, there is a cultural aspect in regard to the corporate inventor that should not be overlooked. We have entered the Post-Industrial Revolution. As mentioned by latter day soothsayers such as Alvin Toffler, the Agricultural Revolution took thousands of years, the Industrial Revolution 300 years, and the Post Industrial Revolution a few decades. Creative individuals and craftsmen prior to the industrial revolution earned what was called a 'just wage' for their services. Then as industry began to organize, so to did labor organize. As a

result, the individual was relegated to the use of a surrogate to negotiate a just wage. The ability of the individual to negotiate a just wage for him/herself is a strong motivational factor.

This last factor particularly contributes to corporate initiative-taking. When all of the factors are taken in total, they contribute to suppression of innovative activity, which impedes the funding process to the extent that otherwise potentially worthwhile innovations are excluded from consideration altogether.

Now let us consider the financial realities of the limited resource innovators. There is a lack of capital for prototype development after patents are granted. This is not usually the case for large corporations, but it is certainly true for the sources of innovation that are some of the most productive--namely, the small research company and the individual inventor. The primary source of capital among these sources are the personal savings or assets of the inventor, personal loans and limited capital resources from other operations in the case of a small research company.

The only institutional sources are certain patent management companies like Battelle Laboratories, Arthur D. Little Company, University Patents, Inc., Cambridge Research and Development Group and National Patent Laboratories, Inc. For large projects, not-for-profit organizations such as Electric Power and Research Institute are available. Also, there are a number of select Innovation Centers adjoined to universities; however, it is more of a setting of innovation environment rather than financial support that is provided in this segment.

Following is a description of the innovation process leading to commercialization. Think of how you might handle it if you felt yourself suddenly moved by the invention urge.

STAGE	EVENT	OUTCOME
1st Stage	Basic Research & Theoretic Studies	Theory Formulation
2nd Stage	Applied Engineering	Theory Verification
3rd Stage	Patent Application	Feasibility Testing
4th Stage	Patent Protection	Patents, Know-How & Other Intellectual Property Secured
5th Stage	Prototype or Working Model Creation	Patent Claims Verified By a Working Model Technical Feasibility Achieved
6th Stage	Product Research	Concept Test, Product Test, Economic Analysis, Test Market, National Roll-Out
7th Stage	Production Prototype	Production Feasibility Verified/Cost Factors Verified
8th Stage	Commercial Entry	Entry into Established Channels of Distribution High Growth if Product Accepted
9th Stage	High Growth Venture	Expansion Requiring Large Capital Infusion, Production Capacity Increase, Design Modifications, Competitor Entry.

The inventor encounters an obstacle in Stage 5, Prototype Development, and Stage 6, Product Research, which is sometimes performed concurrently.

When a fundraiser asks for a prototype and market verification to demonstrate the technical and commercial viability of an innovation, he is placing a burden which, in the experience of this writer, may amount to $50,000 or $100,000 or more on the fundseeker. If an individual does not have the personal resources to contribute to such an effort, he must then attempt to secure them from the capital market.

It is a general lack of business skills on the part of individual inventors and management depth in small research companies that magnifies this problem. Team management is crucial in order to have the specialist marketing, operations and financial skills vital to a promising new venture. It is the rare inventor who possesses both the technical creativity and the business entrepreneurship skills.

It may therefore be construed that an adequate infrastructure does not exist to provide individuals with the business entrepreneurship skills that might be coupled with these persons having technical creativity.

The obvious question arises--namely, "What can be done to encourage such coupling of individuals?" Here, the government has picked up the ball to an extent, . particularly with the National Science Foundation's Research Applied to National Needs Program and the University Innovation Center concepts. The private sector is also showing some initiatives through the development of R & D tax shelters and the concepts of technology development centers advocated by Control Data Corporation, among others.

The independent inventors and small research companies may attempt to pursue alternatives, such as licensing, but similar bottlenecks to the venture capital case often result -- with ofttimes significantly larger bureaucracies to deal with.

Innovators may seek out licensees as potential allies in the commercialization process, but a requirement is still placed on the innovator to demonstrate the technical and market viability of their inventions. This problem may be alleviated to an extent by creating contract research and development agreements with a corporation; however, these tend to be the exception rather than the rule.

Corporations are more risk-averse than venture capitalists, and as such, they have a preference for licensing-in technologies that have already proven themselves in the marketplace.

It is also worthy to note that, according to various industry experts, much of industry, particularly heavy manufacturing, discourages consideration of unsolicited proposals due in large part to the concern about nuisance suits. Some innovators, rightly or wrongly, pursue litigation based on the contention that a corporation has used intellectual property contained in these unsolicited proposals.

On the other hand, innovators are concerned about sharing their creativity with corporations because of various abuses directed at the innovator.

When a corporation is confronted with an offer to engage in some new business activity, it will generally consider the least cost alternatives available to it. These alternatives may be one or more of the following: 1) invent it themselves, 2) design around the technology, 3) acquire comparable technology, or 4) openly violate the patent or intellectual property.

Given the extent to which the judiciary system demonstrates hostility to patent holders and the comparatively meager resources of the independent for patent defense purposes, strong temptations may be brought to bear on the scruples of the larger firms.

In conclusion, it is this writer's opinion that difficulties in obtaining innovation funding result from numerous factors beginning with broad cultural and political environment issues, moving on to motivations of fundraisers and supporters of innovation and ending with the financial and behavioral limitations and realities of the innovator.

Mr. SHAMANSKY. Thank you, Mr. Vollers. Would the gentlemen of the panel—let's go from this end. Dr. Levin?

Dr. LEVIN. Thank you, Mr. Chairman.

A question to Mr. Gillespie about the increasing use of rather new means to fund innovation, limited research and development partnerships. You did mention that there were some problems associated with it.

Could you outline what you see as the key problems and perhaps remedies for that system as applied to a small research and development firm attempting to bring a product to market and raising the funds through such a limited partnership? This obviously has the advantage of taking development costs off the balance sheet of the small company so that it can continue to show a profit out of earnings and yet undertake its development. Also, ownership will not be diluted out as it would be if the company had gone directly to the public for funding. I am mindful of some of the arguments that develop in other types of joint ventures involving a number of parties with different viewpoints.

Unfortunately science is not a democratic process so that you cannot rely upon scientific judgment of a group. Generally, scientific progress is made by one person in defiance of his peer group. How then might this work in a limited partnership?

Mr. GILLESPIE. That is a complex question. I will try to answer briefly. The problems I think arise on two sides. They rise on the side of the investor and they can arise on the company who is attempting to attract the financing, and from our perspective—I mentioned the oil and gas and real estate experiences. The way we see that it can be circumvented is that a firm to use responsible people, and good public accounting firms in developing the documentation which is provided to the prospective investors, and that the investors have some understanding of the field that they are investing in, and that the representation be carefully and thoroughly made.

We feel that a number of the investments that we are involved in, that some independent assessment of the technology by people who are recognized in the field helps to get over the last point.

That is as much as I can add at this point. It is a complex area in terms of the way these things are structured and presented to investors.

Dr. Levin. But in the limited partnership itself, let's say a 50/50 ownership split between the company having the invention and the limited partnership, how do you settle matters in advance with respect to technical decisions and business decisions? The more partners you have, the more views you have.

Mr. Gillespie. They are structured in order to protect the limited liability of the investors so that they don't have a say in the operation of the partnership. If there is a general partner present who is not the company doing the research, then they would have a voice in the administration of the research contract.

In some cases the research contract would have some explicit provisions in it designed to protect the investors and to try to anticipate problems that could occur for inappropriate execution of the contract on the part of the company doing the work.

Dr. Levin. Wouldn't the limited partners have some representation at all with respect to the business processes?

Mr. Gillespie. Only through the general partner. Again if they are involved in the actual decisionmaking, they lose their limited liability protection.

Dr. Levin. Thank you.

Mr. Shamansky. Dr. Ramey?

Dr. Ramey. Mr. Gillespie, by now we know the entrepreneur is an important economic resource. We know you represent an important element in this. You have already told us who the blessed people are. These were the people in splinter groups coming out of companies wherein they have the technology.

They have business knowledge and all the bases are covered as you were saying.

Mr. Gillespie. Yes.

Dr. Ramey. This isn't the way that entrepreneurs will always arrive. Could you give us an indication how the entrepreneur can best be helped to be in this blessed position to approach you?

We have already heard words like business plans and prototypes and so forth.

Mr. Gillespie. I made those comments in the context of saying they are the people who most typically receive financing from the venture capital industry. People like ourselves represent a new layer below the venture capitalists. And where we see a qualified technical entrepreneur with a good project that is addressing a significant market where he has the personal qualities to be able to work effectively with other people in the development of an enterprise, we will work with him in the research and development partnership to eliminate the technical risks and to demonstrate the feasibility of his product which is very important to attract a good businessman.

Once you get over the hurdles of does the widget work, does it do what the entrepreneur says it will do, at that point it is much easier to attract a qualified businessman who understands the industry, and we would take responsibility for working in cooperation with the technical entrepreneur to try to attract that kind of individual.

Then other people will work in combination with the development in order to attract follow-on financing, so it becomes a viable entity.

Dr. RAMEY. Are you telling me that you give them this help?

Mr. GILLESPIE. We would work very closely with them throughout the life of the research and development partnership.

Dr. RAMEY. Perhaps I can come in from another side. Are the Wharton and Georgia Tech programs important to the operation?

Mr. GILLESPIE. I think positive, well-constructed programs run by people like the people at Wharton or Georgia Tech are going to contribute to improving a technical entrepreneur's front-end visibility of what is required. We would be very happy to talk with those kinds of institutions about cooperating in the financing of their developments. So, I see them as complementary approaches.

Dr. RAMEY. Mr. Vollers, since you came out of such a program, do you feel that the university should continue to develop programs specifically for entrepreneurs? Should we do background research into the entrepreneurial process and over a period of time become quite expert in this and provide thousands and hundreds of thousands of people moving into this area?

Mr. VOLLERS. Yes; I think that any kind of incentives that can be provided toward stimulating this area at the university would be greatly helpful. You have some universities such as NYU, for instance—my partner is the professor at the new ventures course there—that provide money to their students to finance some basic expenses that they don't have available to cover the necessary research or out-of-pocket expenses to put together a worthy proposal. And, some universities match students with innovators who need some assistance.

So, any types of assistance that might be provided is greatly helpful.

Dr. RAMEY. You are asking us to become quite involved, you know, to be in contact with all of the elements that the entrepreneurial student would eventually contact.

Mr. VOLLERS. One of the gentlemen before—I don't recall which individual specifically—had mentioned that the schools are providing to the market what the market is demanding. In this particular situation, you want middle managers and the schools will put out middle managers. Particularly in situations where a great amount of the funding for those schools comes from large corporations, they are looking to replace those managers that they need. It has only been in the recent past that the stimulation for entrepreneurship courses has begun to emerge.

But I most definitely think that that is a trend that will continue.

Dr. RAMEY. Thank you.

Mr. SHAMANSKY. Mr. Kloss?

Mr. KLOSS. Just a general observation here. A thread I see running through this from Mr. Shapero talking about NSF's mechanism to help an entrepreneur make contact with the real world to the programs in Control Data or the universities doing this is if there can be any Government involvement directly, I think it is a very healthy sign that everybody has excluded any thought of funding any development toward a commercial venture, carefully excluding science which Mr. Gillespie mentioned. I think we are all talking about highest practical support for pure science. But any—I think the area which can be a very small area because one is providing no physical thing for that entrepreneur to help him learn about what the world of venture capital will be like is thoroughly the most productive area that any direct payment can be made.

And there is a sad part of that in experience where a private enterprise like CDC, Control Data has educated this entrepreneur, when it tries to combine with Federal money, there usually isn't a mechanism. I have in my own company invested in child development and tried to cooperate with the Government on that.

Mr. SHAMANSKY. Let me ask you a question. I think there is a caveat, at least in my own mind. We had in certain areas institutional inability to go into certain areas. I alluded earlier to automobiles and Dr. Sherwood Fossett, the head of Bethel Memorial Institute in Columbus, testified before our transportation committee in Detroit about the technological availability of an automobile that would get 80 to 100 miles a gallon depending on whether it was diesel or gasoline-powered, meeting all safety and other requirements.

Institutionally, there is no evidence that our principal automobile companies have any reason to try to develop such an automobile. Might not the Federal Government have a legitimate interest in something like that?

Mr. KLOSS. The large companies would and will when it is shown that they are losing money by not doing so, which is done by somebody else.

Mr. SHAMANSKY. Supposing they are not losing any money?

Mr. KLOSS. It will happen only when somebody else does that, a smaller company.

Mr. SHAMANSKY. I'm talking about an overriding national concern to get gasoline consumption at the rate of 80 or 100 miles to the gallon. There is no incentive for the automobile companies to make such an automobile unless there is somebody else making such an automobile.

Mr. KLOSS. The pros one is trying to address is how can that somebody else that could make the automobile learn enough. I think it is one mechanism.

Mr. SHAMANSKY. Clearly, an individual in our society——

Mr. KLOSS. An automobile is a difficult example.

Mr. SHAMANSKY. I am responding to the generality of your statement. Ordinarily I would agree fully. I just worry about sweeping generalities. That was my response to that.

Mr. KLOSS. To support no development. I should not have made that generality. A small amount of money can be most efficiently spent by bridging this gap.

Mr. SHAMANSKY. In your case, you managed to do this. My concern, and it was a concern earlier voiced, that the profit motive does not seem to be sufficient on the part of investors or technology partners or their counterparts to do this. Why is that, Mr. Gillespie?

Mr. GILLESPIE. You were out of the room when I made my comments, but one of the points I tried to make is that there certainly are inefficiencies in a large company when it comes to innovation and that has been written about and talked about some today. But I think today that people who are venture capitalists are attracting the qualified persons in that large company who have a good idea to do something and the company says no, we are not interested. There now is a place where he can go. There are increasingly more places where he can go. The companies that are growing up with venture capital assistance consist of people who for one reason or another were turned down in a large company.

Mr. SHAMANSKY. Are you optimistic?

Mr. GILLESPIE. I am not as pessimistic as you are.

Mr. SHAMANSKY. If you are telling me my pessimism is based on lack of information, I am delighted at the news. It isn't that I want to be pessimistic. I keep looking around. When I was a kid going to a five-and-dime store, the junk was produced by Japan and the quality was produced in America. And the definition of a colonial company was one that exported agricultural products and imported manufactured goods. I don't know why that should apply to the United States, since the technology was perfected here.

I am worried about the entrepreneurial factor beyond. We are talking about these people in the area of an original invention, and I think entrepreneurship should go beyond that and address the development and the market. Our entrepreneurs, at least from your testimony, seem to be falling down and I don't know why they are falling down in that area. I just don't understand it, Mr. Kloss. You have had some experience in that area.

Mr. KLOSS. The entrepreneurs that have maintained their business?

Mr. SHAMANSKY. I am assuming you can be an entrepreneur in marketing or wholesalers or retailing or somebody who would pick up. I can't understand why GE, for instance, isn't out searching for this kind of thing instead of relying solely upon its own resources; in other words, the equivalent of a Japanese trading company. Isn't there a sufficient profit in it?

Mr. KLOSS. GE is a good example of those that have done it best. The electric toothbrush was at one time done solely through GE. These products are thought of and introduced.

Mr. SHAMANSKY. When I open up—please excuse the expression—Playboy magazine, which emphasizes consumerism, the consumer life par excellence, it seems to me, all those ads, very few electronic toothbrushes but a lot of other electronic things pushed in there, and they seem to be made primarily overseas. Is that because of cheap labor or have we been beaten at our own game?

Mr. Vollers, do you have an opinion?

Mr. VOLLERS. There are many issues to be considered there. It could be some things such as the obviousness clause in patent law that prevents the use of not only analogous art but nonanalogous art as a basis for preventing further innovations. That is, according to a number of sources, a serious deterrent to the rate of innovation. If you consider the amount of patents that are issued, there are something like 77,000 patents a year which amounts to about 200 patents a day and about 30 of those 200 are issued to the individual innovator. This trend has been static, 15 percent going to the individual innovator, the balance going to the corporate inventor. You can look back before 1970 and you can see it remains the same. It is a flat line. There have to be some basic reasons as to why it stays that flat. If you look at research and development spending from both the public and the private sector, if you look at it in real dollar terms, you can see that that has also been pretty much flat since the beginning of the last decade. So, that is one aspect.

Aspects such as concerns about validity and obviousness, mentioned previously will be depressants to innovation and patenting activities. There is also the issue of disenfranchisement of the corporate inventor, I think, in terms of the valuation of his contribution to the organization.

I contacted one corporate innovator who had developed particular formulas that are used for a security system. I spoke to him about their use and wanted to congratulate him on the newly patented innovation that he had. I said, "Well, you must have handsomely benefited from your corporate employer as a result of this because it is being widely used." And he said, "No, I didn't get anything for it at all." I said, "Where did you invent this?" He said, "I invented it at home." I said, "Did you use the corporate resources?" He said, "No." I said, "Is it written in your corporate job description?" He said, "No."

Mr. **Shamansky**. The man needed a lawyer desperately. [Laughter.]

Gentlemen, I want to thank you very much for attending our hearings. I think it was an interesting way of eliciting very, very good testimony. I want to thank the panel of experts for the questioning. You did a first-rate job. I want to thank you gentlemen. Thank you very much.

[Whereupon, at 1:42 p.m., the hearing was adjourned.]

SMALL, HIGH TECHNOLOGY FIRMS, INVENTORS AND INNOVATION

WEDNESDAY, JULY 22, 1981

House of Representatives,
Committee on Science and Technology,
Subcommittee on Investigations and Oversight,
Washington, D.C.

The subcommittee met at 9:05 a.m. in room 2325, Rayburn House Office Building, Hon. Albert Gore, Jr. (chairman of the subcommittee) presiding.

Present: Representatives Gore, Shamansky, and Walker.

Mr. **Gore**. The subcommittee will come to order.

I would like to welcome all of our guests this morning. Yesterday we heard from witnesses from the private sector concerning programs designed to promote technological innovation through small, high techology firms, and independent inventors. Today we will turn to the activities of the Federal Government, the National Science Foundation, the Small Business Administration, and the National Bureau of Standards, Department of Energy, energy-related inventions program.

Before we go on, I think it might be appropriate to note an article in yesterday's Washington Post by Robert J. Samuelson, who frequently writes an article entitled "Economic Focus." The importance of these hearings was further underscored by Mr. Samuelson in his writing yesterday, and I would like to quote a brief excerpt.

> A basic dilemma of our modern economic system is how to reconcile freedom with security. As more and more people work for large organizations—either corporations or government bureaucracies—the issue becomes increasingly personal. Must we either chain ourselves to the benevolence of a big organization or attempt to play out the fantasy of the last rugged individualists? Possibly two-fifths of the labor force toil for firms of 500 or more. In a sense this is the triumph of enlightened capitalism. Since the dawn of the industrial age workers have striven to achieve economic security. To a large extent, we have achieved it. But the cost may be a loss of individual cost and creativity.

These hearings are in effect examining that creative spirit and finding it alive and well in small, high technology firms and inventors. In order to insure that this entrepreneurial spirit remains alive, it became apparent during yesterday's testimony that large corporations, university innovation centers, and venture capitalists all must serve as an interface to bridge the gap created by the lack of so-called shovel money in our system. They provide market analysis and business plan development so that the inventor or new firm can qualify for follow-on venture capital.

The Federal Government also has several programs to foster technological innovation by providing needed shovel money. Specifically, we will be hearing from the National Science Foundation, the Small Business Administration, and the National Bureau of Standards/Department of Energy.

In particular, we will want to determine: One, what are the objectives of their programs; two, are these programs designed to provide shovel money or seed capital to the riskiest part of the innovation process; three, how well have those objectives been reached; four, what can be done to improve the programs?

As we did yesterday, we are pleased to have four independent inventors or executives of small, high technology firms who have had personal experience with these agencies. Their questions at the conclusion of the panelists' oral testimony we hope will be most enlightening.

It is with particular pleasure that I welcome the first panel representing the National Science Foundation. Roland Tibbetts, the program manager for innovation and small business, is the "inventor" of the successful small business innovation research program, SBIR, and Dr. Wayne Brown, director of the Utah Innovation Center sponsored by NSF. Gentlemen, welcome. Without objection, the entire text of your prepared statements will be put into the record at this point. We are pleased to have you join us and we would like to begin with you, Mr. Tibbetts.

Mr. **Tibbetts**. If you don't mind, I would like to read my statement.

Dr. **McMahon**. That is fine.

STATEMENT OF ROLAND TIBBETTS, PROGRAM MANAGER FOR INNOVATION AND SMALL BUSINESS, NATIONAL SCIENCE FOUNDATION

Mr. **Tibbetts**. The National Science Foundation's small business innovation research program was specifically designed to increase technological innovation through small, high technology firms. It was initiated in 1977, in part as a result of the congressional requirement at that time that 10 percent of NSF research under the research applied to national needs or RANN program be expended with small business concerns.

The objectives of the SBIR program are to: increase the opportunity for small, high technology firms to participate in Federal R. & D.; support quality research of interest to NSF on advanced ideas that are too high risk or long term for small firms to obtain private investment; couple NSF research to follow-on private venture capital or other support; increase technological innovation and commercial applications from Government-funded research; to introduce technology transfer at the beginning of the research planning process rather than after the Government R. & D. has been completed or the hardware produced; and improve the economic return on investment from Federal research.

This program is unique in that it couples Federal R. & D. in phases I and II to follow private venture capital in phase III. Government funds are spent solely on agency objectives; private funding pursues commercial objectives. In effect, the Government research can serve as preventure capital in the innovation process.

Phase I supports small, up to $30,000, 6-month awards in NSF program areas. Phase I is to determine whether the research idea appears feasible and whether the firm can do high quality research. Phase II is the principal research project where awards average $200,000 for 1 to 2 years. Phase III is to pursue potential commercial developments from the Government research where possible and is funded entirely with private capital.

The program provides direct incentives for the small firm to pursue commercial objectives from Government R. & D. SBIR asks proposers two questions in addition to those related to agency R. & D. needs in phase I: One, does the proposed Government research also have commercial potential; and two, do you intend to obtain private follow-on capital to pursue commercialization of the research? "Yes" answers receive extra points of merit in the evaluation process. In phase II the phase I winners are asked, but not required, to obtain an actual commitment for private follow-on funding for phase III at least equal to that requested from NSF in phase II. Those obtaining such a commitment also receive extra points of merit in the evaluation of their phase II proposal. Phase III commitments are normally obtained from a venture capital or large industrial firm.

This approach utilizes Federal R. & D. as a base for technological innovation in the private sector at little or no additional cost to Government. It utilizes private sector objectivity to determine the commercial potential of the research and also evaluation of the management, market, and future financial requirements. Government is not directly involved in this analysis in negotiations with the third party, but rather solely in considering any follow-on commitment presented. Government evaluation is primarily based upon the technical merits of the research proposed. The extra point of merit is considered, however, when proposals are otherwise judged to be of approximately equal merit.

The inclusion of this incentive to pursue commercial applications from Government research in the proposal evaluation process is the key to the stimulation of technological innovation from the program. When small firms are asked if the research proposed to Government has commercial applications and this is a key factor in the proposal evaluation process, the small firms find many potential applications and often the private funds to pursue the applications in phase III. They also have an incentive to contract venture capital and larger industrial firms for the important follow-on funding.

The program does not replace private funds with public funds. Government funding again is spent solely on agency objectives. The commitment for phase III, however, is contingent upon the firm receiving a phase II award and the success of the phase II research. It is not necessarily enforceable, but serves as a strong incentive to be fulfilled by both parties.

The program is highly competitive with over 2,000 proposals received and only 200 awards made to date. Proposals have been received from firms in 49 of the 50 States plus the District of Columbia, and awards have been made to firms in 30 States and the District.

Four solicitations have been conducted to date. The 1977 solicitation has completed phase II and seven to eight firms are in phase III. The 1979 solicitation is starting phase II. The 1980 solicitation has just completed phase I and submitted phase II proposals. Approximately 700 proposals were received April 1 under the 1981 solicitation and are currently being reviewed. Eighty phase I awards are planned. In 1977, one-half of those projects found most promising in phase I were funded in phase II.

In addition to the research conducted in a wide range of program areas, the 21 phase II grantees in the 1977 solicitation have received $17 million in follow-on funding. Another $10 to $20 million is anticipated within 6 weeks from final negotiations with one firm now in progress. These 21 firms have also doubled their employment. There have been a number of new firms started as a result of the program and some 15 inventions reported. The program supports high risk research on ideas from small business firms in such areas as materials research, bio-sources of materials, genetic technology, advanced manufacturing processes, advanced chemical processes, industrial biological processes, microelectronics, communications and systems, computer sciences and engineering, robotics, scientific and industrial measurements, radiation processing and control, machinery research, advanced automotive research, food process engineering, marine and mineral resources, environmental technology, tunneling, drilling, excavation and dredging, earthquake engineering and science and technology to aid the handicapped. An increasing number of industrial and venture capital firms are showing interest in the program as the SBIR topics have gradually become more industrially relevant.

The results to date have been highly encouraging. One of the recent winners is The Merrick Corp., of Nashville, for research on adaptive arc tracking for automated welding. They are obtaining that through determining the feasibility of using electrical signals as part of the actual welding process and sensing the weld path to be implemented into the automatic welding processes.

In another example, NSF funded OMEX, a small California electronics firm, for laser-optics research for $25,000 in phase I and $147,000 in phase II. This assisted OMEX in obtaining an additional $3.5 million of venture capital from the Heizer Corp., a Chicago small business investment company (SBIC), to pursue conversion of the research into an innovative new product area of electronic filing.

OMEX has since obtained additional funding from Heizer and $4 million from the Nation's largest title insurance company to build electronic filing equipment. The storage density based on the NSF laser optics research allows OMEX to store from 70,000 to 100,000 document pages or the equivalent of about 14 file cabinets in an area equivalent to a 6- to 7-inch cube in the computer. Both the company and Heizer believe that electronic filing represents a whole new field that has enormous growth and productivity implications. Copy is instantly read by the new system without the need for keypunching. The information can be automatically stored, recalled on a display terminal, and hard copy produced when necessary.

In the mining and drilling field, Terra Tek, Inc., of Salt Lake City received NSF awards for metal fracture toughness research. Prior to the completion of the phase II 2-year research effort, Terra Tek had used the research results to design, build, and market worldwide, with its own funds, an instrument to measure the fracture toughness of mining and oil drilling bits. Terra Tek is currently expanding the product into a full product line of instruments to measure other kinds of metal fracture toughness in many different industries. This is an example of a high-risk small market product that the company feels might not have been built at all by others, due to the difficulty of doing so and the small market which is seldom of interest to large firms. The company foresaw the potential of converting the fracture toughness research into a measurement instrument and the National Science Foundation was interested in funding the initial front-end highest risk research on metal fracture toughness.

In the agricultural field, Soil and Land Use Technology of Columbia, Md., was funded to investigate the potential for foreign crops, for the most part, which grow under stress conditions such as in arid, wet, or saline environments, to succeed in the United States under similar geographical conditions. Their research is perhaps the most comprehensive work of its kind in relation to the United States and is in wide demand by academic, industrial, and other sources both in the United States and overseas. Both the BBC and Business Week have covered it.

Equally important, due to the design and incentives of the SBIR program, SALUT, the acronym for the company, has pursued commercial applications of the results. It has obtained $130,000 in follow-on funding from the American Newspaper Publishers Association to further investigate kenaf, a hemp-like plant which is native to Asia, as a source of paper pulp for newsprint in the United States. Soil and Land Use Technology is now growing kenaf on an experimental basis for seed production in south Texas. Other plants investigated also appear to have U.S. potential such as grain amaranth, a high protein cereal additive; pigeon pea, a vegetable of particular interest currently to other nationalities, which are growing in the U.S. population; and crambe, a crop that yields industrial quality oil. There are other biological projects including one to Mr. Mason of Simco, Inc., of Connecticut. He is pursuing the Chinese tallow tree as a source of oil for industrial and food purposes.

Collaborative Research of Waltham, Mass., received awards to conduct research on enhancing animal protein production by novel genetic means. The NSF funding of $25,000 in phase I and $239,000 in phase II resulted in the firm obtaining an additional $5 million of follow-on funding from Dow Chemical. This private funding was subsequently increased to $7 million and another $10 to $20 million private placement for up to 20-percent ownership of Collaborative Research by four outside firms is currently in negotiation. NSF funded the initial research in 1977, well before the Supreme Court decision which allowed patents in this field and opened up the area to venture capital. The NSF research was also the first genetics work the firm conducted, but it had an idea which was of interest to NSF scientists. Dr. Orrie Friedman, president of Collaborative Research, told me that he felt the idea had a one in a thousand chance of success, but if successful, it would have a major impact. It now appears probable that the research will be successful and the impact in terms of obtaining millions of additional research dollars for the company and indirectly for society, has already been substantial.

In the production area, Advanced Mechanical Technology of Newton, Mass., submitted an idea for research on placing a radioisotope on the cutting edge of machine tools for automatic production setups. It would then place a sensor beside the isotope to determine when it was interfered with, to shut off the machine when there is interference, and to indicate the shutdown on a control panel. Interference with the isotope meant the tool was dull or there has been tool breakage. This could obviously be important in limiting waste in machining operations, particularly as we develop more automated manufacturing. However, making an isotope survive in this cutting-edge environment and remain there as long as the tool was still sharp was a challenging task. GE, Ford, Chrysler, and Raytheon showed interest in the results. Advanced Mechanical Technology, Inc., is currently working with another major U.S. industrial firm which is planning a new highly automated manufacturing plant for metal machining operations. The current problem is that although the Nuclear Regulatory Commission anticipates no problem clearing the very low-level radiation from the isotope, the firm faces more research and 2 years of effort to gain clearance by this Government agency. I might add that the Japanese invited the compoany's president immediately to Japan and he went.

The small business innovation research program has also funded startups and one-person firms. One-half of the awards to date have gone to firms with 10 or less employees. 20 percent have gone to firms with one or two employees.

This represents a cross-industry sampling of NSF research funded under the small business innovation research program which has resulted in commercial application and in some cases, we believe, technological innovation. While these are some of the more advanced projects to date, they represent but a few of the 200 projects funded under the program.

This concludes my statement, Mr. Chairman. I would be pleased to answer any questions the committee may have.

[The prepared statement of Mr. Tibbetts follows:]

PREPARED STATEMENT OF ROLAND TIBBETTS, PROGRAM MANAGER FOR INNOVATION AND SMALL BUSINESS, NATIONAL SCIENCE FOUNDATION

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Support quality research of interest to NSF on advanced ideas that are too high risk or long term for small firms to obtain private investment.

Couple NSF research to follow-on private venture capital or other support.

Increase technological innovation and commercial applications from government funded research.

To introduce technology transfer at the beginning of the research planning process rather then after the government R&D has been completed or the hard-ware produced.

Improve the economic return on investment from Federal research.

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The program provides direct incentives for the small firm to pursue commercial objectives from government R&D. SBIR asks proposers two questions in addition to those related to agency R&D needs in phase I: (1) Does the proposed government research also have commercial potential and (2) Do you intend to obtain private follow-on capital to pursue commercialization of the research? "Yes" answers receive extra points-of-merit in the evaluation process. In phase II, the phase I winners are asked (but not required) to obtain an actual commitment for private follow-on funding for phase III at least equal to that requested from NSF in phase II. Those obtaining such a commitment also receive extra points-of-merit in the evaluation of their phase II proposal. Phase III commitments are normally obtained from a venture capital or large industrial firm.

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Four solicitations have been conducted to date. The 1977 solicitation has completed phase II and 7-8 firms are in phase III. The 1979 solicitation is starting phase II. The 1980 solicitation has just completed phase I and submitted phase II proposals.

Approximately 700 proposals were received April 1 under the 1981 solicitation and are currently being reviewed. Eighty phase I awards are planned. In 1977, one-half of those projects found most promising in phase I were funded in phase II.

In addition to the research conducted in a wide-range of program areas, the 21 phase II grantees in the 1977 solicitation have received $17 million in follow-on funding. Another $10-$20 million is anticipated within six weeks from final negotiations with one firm now in progress. These 21 firms have also doubled their employment. There have been a number of new firms started as a result of the program and some 15 inventions reported. The program supports high-risk research on ideas from small business firms in such areas as materials research, bio-sources of materials, genetic technology, advanced manufacturing processes, advanced chemical processes, industrial biological processes, microelectronics, communications and systems, computer sciences and engineering, robotics, scientific and industrial measurements, radiation processing and control, machinery research, advanced automotive research, food process engineering, marine and mineral resources, environmental technology, tunneling, drilling, excavation and dredging, earthquake engineering and science and technology to aid the handicapped. An increasing number of industrial and venture capital firms are showing interest in the program as the SBIR topics have gradually become more industrially relevant.

The results to date have been highly encouraging. For example, NSF funded OMEX, a small California electronics firm, in laser-optics research for $25,000 in phase I and $147,000 in phase II. This assisted OMEX in obtaining an additional $3½ million of venture capital from the Heizer Corporation, a Chicago small business investment company (SBIC) to pursue conversion of the research into an innovative new product area of electronic filing. OMEX has since obtained additional funding from Heizer and $4 million from the nation's largest title insurance company to build electronic filing equipment. The storage density based on the NSF laser optics research allows OMEX to store from 70,000 to 100,000 document pages or the equivalent of about 14 file cabinets in an area equivalent to a 6-7 inch cube in the computer. Both the company and Heizer believe that electronic filing represents a whole new field that has enormous growth and productivity implications. Copy if instantly read by the new system without the need for keypunching. The information can be automatically stored, recalled on a display terminal, and hard copy produced when necessary.

In the mining and drilling field, Terra Tek, Inc. of Salt Lake City received NSF awards for metal fracture toughness research. Prior to the completion of the phase II two year research effort, Terra Tek had used the research results to design, build and market world-wide, with its own funds, an instrument to measure the fracture toughness of mining and oil drilling bits. Terra Tek is currently expanding the product into a full product-line of instruments to measure other kinds of metal fracture toughness in many different industries. This is an example of a high-risk small market product that the company feels might not have been built at all by others due to the difficulty of doing so and the small market which is seldom of interest to large firms. The company forsaw the potential of converting the fracture research into a measurement instrument and the National Science Foundation was interested in funding the initial front-end highest risk research on metal fracture toughness.

In the agricultural field Soil and Land Use Technology of Columbia, MD was funded to investigate the potential for foreign crops, for the most part, which grow under stress conditions such as in arid, wet, or saline conditions. Their research is perhaps the most comprehensive work of its kind in relation to the U.S. and is in wide demand by academic, industrial and other sources both in the U.S. and overseas. Both the BBC and Business Week have covered it. Equally important, due to the design and incentives of the SBIR program, SALUT, the acronym for the company, has pursued commercial applications of the results. It has obtained $130,000 in follow-on funding from the American Newpaper Publishers Association to further investigate Kenaf, a hemp-like plant which is native to Asia, as a source of paper pulp for newsprint in the U.S. Soil and Land Use Technology is now growing Kenaf on an experimental basis for seed production in South Texas. Other plants investigated also appear to have U.S. potential such as grain amaranth, a high protein cereal additive; pigeon pea, a vegatable of particular interest currently to other nationalities which are growing in the U.S., and crambe, a crop that yields industrial quality oil.

Collaborative Research of Waltham, Massachusetts, received awards to conduct research on enhancing animal protein production by novel genetic means. The NSF funding of $25,000 in phase I and $239,000 in phase II resulted in the firm obtaining an additional $5 million of follow-on funding from Dow Chemical. This private funding was subsequently increased to $7 million and another $10-$20 million private placement for up to 20 percent ownership of Collaborative Research by four outside firms is currently in negotiation. NSF funded the initial research in 1977, well before the Supreme Court decision which allowed patents in this field and opened up the area to venture capital. The NSF research was also the first genetics work the firm conducted but it had an idea which was of interest to NSF scientists. Dr. Orrie Friedman, president of Collaborative Research told me that he felt the idea had a one in a thousand chance of success, but if successful, it would have a major impact. It now appears probable that the research will be successful and the impact in terms of obtaining millions of additional dollars for the company and indirectly for society, has already been substantial.

In the production area, Advanced Mechanical Technology of Newton, Massachusetts submitted an idea for research on placing a radio-isotope on the cutting edge of machine tools for automatic production set-ups. It would then place a sensor beside the isotope to determine when it was interfered with, to shut off the machine when there is interference, and to indicate the shut-down on a control panel. Interference with the isotope meant the tool was dull or there has been tool breakage. This could obviously be important in limiting waste in machining operations, particularly as we develop more automated manufacturing. However, making a isotope survive in this cutting-edge environment and remain there as long as the tool was still sharp was a challenging task. GE, Ford, Chrysler, and Reytheon showed interest in the results. Advanced Mechanical Technology, Inc. is currently working with another major U.S. industrial firm which is planning a new highly automated manufacturing plant for metal machining operations. The current problem is that although the Nuclear Regulatory Commission anticipates no problem clearing the very low-level radiation from the isotope, the firm faces more research and two years of effort to gain clearance by this government agency.

The Small Business Innovation Research program has also funded start-ups and one person firms. One-half of the awards to date have gone to firms with ten or less employees.

This represents a cross-industry sampling of NSF research funded under the Small Business Innovation Research program which has resulted in commercial application and in some cases we believe, technological innovation. While these are some of the more advanced projects to date, they represent but a few of the 200 projects funded under the program.

This concludes my statement Mr. Chairman. I would be pleased to answer any questions the Committee may have.

Mr. GORE. Thank you for an excellent statement. I might note for the record, that during the last administration's domestic policy review, if I am not mistaken, your program was identified as the most innovative of the domestic programs that have been established.

Mr. TIBBETTS. One of those.

Mr. GORE. One of the most innovative. We are honored to have you here today.

Dr. Brown, I mentioned you are director of the Utah Innovation Center at the University of Utah. I did not mention you are also dean of engineering at that institution. I am pleased to have you with us this morning. Your program is funded by the NSF, and we invite you to proceed.

Dr. BROWN. Thank you. By way of correction, I have resigned as dean in the last couple of years and I am now a professor of mechanical engineering.

STATEMENT OF WAYNE S. BROWN, DIRECTOR, UTAH INNOVATIVE CENTER, UNIVERSITY OF UTAH

Dr. BROWN. Our center has taken the attitude that small, high technology firms can be of great benefit to our country. As such, we strive to help such firms get started. Our basic approach is to find people with interesting ideas that we feel are capable of organizing and running a company and provide assistance to them. Generally, the assistance is in the form of locating them in our facility where we provide secretarial service, technical assistance, legal counselling, administrative help and so on, to enable them to get their business underway with a minimum of difficulty.

Having started several small technical firms myself, I am aware of the problems that one encounters in trying to get a business underway, and our goal is to provide intelligent assistance and make it easy for a person to go into business. We are not able to help very many people. Our budget and facilities are not that large. We are therefor very selective in the people we select. I would like to describe two small companies that have started in the innovation center.

One of these is called Weathercaster, Inc. This was begun by a meteorologist who came to us with a hand-held calculator that would produce weather forecasts. He had programed the common parameters that one would think of in terms of weather conditions into this calculator. An operator simply inputs current conditions and the calculator produces a forecast. He tried to sell this concept to a number of large companies without success.

We were impressed with the individual and his device, and we asked one of our staff people to give him some assistance in looking into the business possibilities. The staff person was an MBA candidate whom we first met when he was a student in our innovation and entrepreneurship class. The company finally evolved around the idea of a weather system which would be marketed to TV studios to enable them to make better weather forecasts and better presentations of the weather on the evening news.

This system now sells for about $70,000. At this point they have sold four of those systems, and we feel the company has good prospects. This has all taken place within the last 12 months. When it became apparent that they had an idea that did seem to have some merit, we were able to convince a couple of friends to meet with them, and as a result of that meeting these people invested $50,000 to get the company started. This was supplemented by an SBA guaranteed loan.

As they hired staff they soon outgrew the small amount of space allocated to them in our center and we suggested that they move into other facilities in the university's research park.

Another company that we are very excited about is a bioengineering company. A very well qualified bioengineer approached us with a concept for a new ventilator, a breathing apparatus to help infants with respiratory problems. We were intrigued with the technology, very impressed with the individual's technical qualifications, and saw that he had an obvious interest in business.

We helped him negotiate the technology away from a company that he was working with and moved him into the center. We have provided technical and administrative assistance and also travel money for him to make presentations to medical people, technical meetings, and venture capital groups. At the present time the company is preparing a model for clinical testing in hospitals. He has recently negotiated funding from private sources which should carry him well into the second year of his organization

We think this technique for assisting technical innovators in forming companies is worthwhile, since it permits the individual to carry out his activities in a friendly and supportive environment.

We take an equity position in firms we assist on behalf of the university. Stock is actually transferred to the university for our efforts, and that way eventually a center of this type should become self-sufficient. However it takes time to get these companies to a point where there is any liquidity in the stock, Some kind of startup and interim funding is necessary to establish a center of this type.

We now believe that in 2 years the equity positions that we have taken in these two companies will achieve a value equal to all of the money that has been spent in the Utah Innovation Centers.

If that is the case, what we are doing is demonstrating the feasibility of eventually making innovation centers private. We think this technique can be replicated at other locations.

We have been very pleased with our support from the National Science Foundation. We now have two other companies in the embryo stage. Both of them have applied to Mr. Tibbetts' program for funding. We think that is an excellent mechanism for getting additional funds. We also think it is useful to the companies to have the center available to provide advice and counsel.

At this point we are rather enthusiastic about the program. However, as you may know, the funding for these programs is in dire jeopardy and at this point the National Science Foundation has informed us that this is our final grant year. We are looking for other ways now to continue on the activities of the center.

Thank you.

[The prepared statement of Mr. Brown follows:]

THE
UNIVERSITY
OF UTAH

UTAH
INNOVATION
CENTER

391 G SOUTH CHIPETA WAY
RESEARCH PARK
SALT LAKE CITY UTAH 84108
801-581-3433

Committee on Science and Technology
House of Representatives Testimony, July 22, 1981

Wayne S. Brown, Director, Utah Innovation Center, University of Utah

Considerable evidence exists which illustrates that small technological firms have had a significant impact on American productivity. Yet, our country still lacks effective mechanisms for encouraging the formation of such companies and providing guidance and capital for their growth. The Utah Innovation Center was established through funds from the Industry, Science and Technological Innovation Program of the National Science Foundation as part of an experiment to determine mechanisms for stimulating high technology business start-ups. As director of that center since its inception approximately two and one-half years ago, I have had the opportunity to experiment with several start-up concepts. At this time I am convinced that the mechanism we have developed is an effective and economical solution to this problem; and, furthermore, I believe it can be replicated at other locations.

Our basic concept is to provide help to capable people with promising ideas. For the small number of people selected to receive assistance from our center, we provide management, technical, secretarial, accounting and legal assistance and also space and facilities. In essence we assist the technical innovator in the start-up process by eliminating some of the necessary, but extraneous, problems which he or she faces. The center uses its limited funds to help the innovator reach a point where outside capital can be attracted.

The help generally consists of business planning but may include some technical development effort as well. Once the center is convinced the concept is worthwhile it will use its influence to assist in raising outside capital and arranging bank loans. We prefer to maintain the funding at a level just sufficient to meet reasonable progress schedules with defined mileposts during early stages of development. As the company grows we encourage moving to larger quarters making our space available for others. The center takes an equity position in the company, and one of the center staff serves as a director.

Preliminary data indicates that an innovation center operating with this approach can be economically self-sufficient in the range of 5 to 10 years, however; initial operating money must be available to sustain the organization during its formative years.

The attached paper describes the activities of the Utah Innovation Center in more detail and provides two examples of companies which have been started within the center.

THE UTAH INNOVATION CENTER--
A LAUNCHING PAD FOR NEW TECHNOLOGY ENTERPRISES

Wayne S. Brown, University of Utah
Ramon E. Johnson, University of Utah
William R. Bowen, University of Utah

ABSTRACT

The organization, operation and philosophy of the Utah Innovation Center are explained. Brief descriptions of center projects, i.e., sponsored ventures, are given to illustrate center operations. Lack of capital for "seed" stage investments is set forth as a critical barrier to formation of new technology-based firms. The center's business development program is described. Necessary and sufficient conditions for successful establishment of new technology-based ventures are hypothesized.

UTAH INNOVATION CENTER

The objective of the Utah Innovation Center is to promote, encourage and assist the start-up of new technology-based business enterprises. As one of the four universities funded by the National Science Foundation innovation center experiment, we have had an opportunity to attempt to utilize the resources of the university to aid technical entrepreneurs in establishing companies.

The case regarding the ability of small technology-based companies to bring innovative products to the marketplace and to compete effectively in both national and international markets has been well documented.

Given the desirability of small innovative firms, it follows that creation of greater numbers of new technology-based firms will also be desirable. This case can be made on a number of points, but the following are adequate:

1. Small firms are more effective than large firms at creating jobs.[1]

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[1] Birch, David L., The Job Generating Process, U.S. Department of Commerce, 1979.

2. Small firms are more effective than large firms at innovation.[2]

3. The U.S. competes effectively on the world market in high technology products.

4. Communities like high-technology companies because salaries are high and pollution is low.

If these points are accepted as valid, one must conclude in the light of inflation, sagging productivity, and balance of trade difficulties that the creation and growth of high-technology firms is vital to our national interest. Indeed, we should consider the establishment of such firms a national priority and take major steps to improve their well-being.

In recent years universities have become rather bold in introducing courses in entrepreneurship.[3] Is it appropriate to go a step farther with a few carefully selected entrepreneurs and actually utilize the vast resources of the university to assist them in getting started? We believe the answer to this question is yes, and fortunately we have been supported in that action by both the administration of the University of Utah and the National Science Foundation.

Due to limited budget, we select only a few projects from the many presented for our consideration; but those accepted receive extensive support. We recognize that "going into business" involves many things which are not related to the central theme of the business such as locating and renting space, hiring a secretary, buying office furniture, obtaining legal help to draw up articles of incorporation, selecting an accountant to set up the books, etc. We eliminate those problems by moving the entrepreneur into the innovation center where these things are all provided. We are also willing and able to supply engineering and technician support, machine shop services, assistance in preparing business plans by trained professionals, and most important an atmosphere where technical entrepreneurship is the theme of the day. As the project progresses, we will assist in locating venture capital. At some appropriate point, hopefully within eighteen months, we will relocate the company either because it has become capable of paying its own way, or because it doesn't look like it will be able to succeed.

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[2] National Science Foundation, Science Indicators, 1976.

[3] Vesper, Karl H., Entrepreneurship Education--A 1978 Update.

Current Projects

Our center is young and it is far too early to judge its success or failure; however, a progress report on two of our current projects will serve to illustrate how the model operates.

Weathercaster

A professional meteorologist approached the center for assistance in getting a hand-held weather forecasting calculator to the market. Although we had some concern about a company selling relative low-cost devices to the consumer market, we agreed to support the project. An MBA student whom we had first met in our entrepreneurship course and hired part-time was assigned to help the inventor. Through an interesting chain of events, Weathercaster evolved over a period of eight months from a hand-held calculator to a graphics system used by TV studios to present improved and more entertaining presentations of the weather portion of the evening news. A corporation has been formed which includes the center as a stockholder and a senior staff member as a director. Through personal contacts of the center management, we have raised seventy thousand dollars in equity capital; and with assistance from the center, an SBA-guaranteed loan for $150 thousand has been secured. The company now has 10 employees and expects their first sales in mid-1981.

BLSI

After discussions lasting several months, Bunnell Life Systems, Inc. was incorporated, again with board and equity participation by the center, to market a novel respiratory support device developed by a highly qualified and experienced bioengineer. The center assisted the engineer in negotiating the purchase of the technology from his former employer and then provided office and laboratory space in the center. A staff engineer from the center undertook the development of an improved valve for the device. An electronics engineer and a computer specialist were hired as consultants to assist the bioengineer in development. Electronics supplies and machine shop services were provided. Travel to the East Coast to demonstrate the device to physicians and potential investors was covered by the center. A detailed business plan was prepared by the entrepreneur with extensive help from center personnel. At this time the machine is being demonstrated in a hospital, and venture capitalists are making regular visits to the center to determine if they have an investment interest.

Several other projects are in the formative stage, and the center is working on one of its own projects. The atmosphere is exciting and changes from elation to depression on a daily basis depending on current successes or failures.

Numerous visitors come to the center, and our entrepreneurs have plenty of opportunities to develop their show-and-tell skills.

Seed Capital

It is apparent to anyone involved in the innovation-entrepreneurship business that "seed" capital, that initial money needed by an inventor to demonstrate that his concept has hope, is in short supply. The highly organized venture capital industry of the U.S. is geared to provide funds at a later date. The really high risk seed capital is generally only available in the informal venture capital market.[4, 5] Perhaps organizations such as the Utah Innovation Center can serve a useful purpose in assisting at the early stage. We are currently seeking private capital to assist us in the endeavor. Our goal is to obtain and establish a private seed capital fund with the center serving as manager. Investments from the fund would be limited to something less than $40,000, which when combined with center resources would be used to demonstrate viability of the project. When a venture looks promising the investors who put up the seed capital will have the first opportunity to invest.

Selection Process

The selection of good projects and capable entrepreneurs is vital to the long-term success of the center concept. We have adopted an elitist point of view which demands exceptionally high qualifications in terms of education and experience of the entrepreneur. We feel these qualifications must be consistent with the project. Typically we look for a strong technical leader who shows signs of being willing to work with business people. We can assist in finding these people to round out the team.

The Utah Innovation Center has reviewed just under 1,000 submissions of projects in our two years of formal operation. The great majority of these were of low quality or inappropriate to our program because of geographic reasons, interest of the inventor in something other than formation of a new firm, etc.

Our initial screening process eliminates these quickly

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[4] Productivity, Innovation, and Small Business Entrepreneurship, A Report on a Public Hearing before the Chief Counsel for Advocacy of the U.S. Small Business Administration, May 28-29, 1980, pg. 1.

[5] Wetzel, William E., Jr., "Technovation and the Informal Investor," Technovation, Vol. 1, No. 1, February, 1981, pg. 25.

and with as little expense as possible. Unlike some of the other innovation centers, we do not evaluate inventions as a service to inventors. If a project passes the initial screen, our process of examination becomes more involved but still informal. Essentially it consists of a series of hierarchical interviews with center management, the project proponents, and if necessary, technical or business faculty of the university. The first interview occurs with a center staff member assigned to invention evaluation, the second is with the administrator of the center and the third, if our interest remains, with the center director. In the interviews we attempt to determine the potential of the project, depth of understanding of the proponent concerning the problem the invention addresses, his background in the field it concerns, and knowledge of the structure of the industry and markets. Important subjective judgements are made concerning the ability of the inventor to found and manage a new technological venture and his degree of interest in doing so.

Business Development Program

Out of the thousand projects screened, a list of approximately 20 has been selected for possible partial sponsorship by the center toward a new venture. About half of these stem from University of Utah research.

After selection as a potential project, negotiation with the inventor begins toward an agreement for sponsorship. Agreement must be reached before commitment of center resources beyond the selection stage. The center prefers to commit budget in a incremental fashion to reduce our exposure while permitting us to work with and assess the project at hand. A phasing chart (Figure 1) is shown below which is used to explain to the inventor the process we foresee in establishing a new firm. We have found that pursuit of active innovation center projects by student teams in our innovation and entrepreneurship course sequence can be highly effective both in terms of feasibility assessment of the project and the educational goals of the courses.

It is important that the inventor understand from the outset that dilution of his interests will occur as investment capital is brought in from various sources to advance the project. Ideally this phasing program would permit the center to bring material assistance to a fledgling venture with an out-of-pocket expense budget in the range of $30,000 per project and the balance of funds provided by sophisticated investors.

Each phase of the program marks a distinct business transition, a milestone and a continuation review decision. After Phase II, Feasibility Assessment, for example, the project cannot continue unless the difficult task of securing seed capital is met successfully. If initial investment

UTAH INNOVATION CENTER

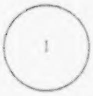
TECHNOLOGICAL BUSINESS DEVELOPMENT PROGRAM

September 1980

Ownership:

100% - Inventor

(Inventor owns 100%)



Phase I
Evaluation and Negotiation

Three Part Evaluation

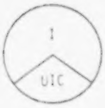
Duration: 30 days

Objective: Project Screening and Selection

Ownership:

70% - Inventor
30% - UIC

(Equity sharing agreement with UIC 10% - 30%)



Phase II
New Venture Feasibility Assessment

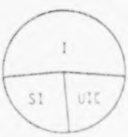
Budget: $5,000 to $10,000 expended from UIC budget not including staff time

Duration: 6 months

Objective: Technical and business feasibility determination

Ownership:

52.5% - Inventor
22.5% - UIC
25.0% - Seed Investors



Phase III
Seed Capital Formation

Budget: $5,000

Duration: 6 to 8 months

Objective: Securing adequate early investment to carry the project to first sales commitments

Ownership continues the same as that in Phase III

Phase IV
New Enterprise Development

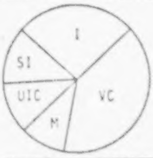
Budget: $20,000 to $150,000 budgeted from combination of UIC and outside sources

Duration: 18 to 24 months

Objective: Complete business preparation

Ownership:

26.25% - Inventor
11.25% - UIC
12.50% - Seed Investors
40.00% - Venture Capital
10.00% - Management



Phase V
Start-up Capital Formation

Budget: $5,000

Duration: 6 months

Objective: Acquisition of adequate capital to launch the venture on sound terms

Ownership continues the same as that in Phase V

Phase VI
Continuing Assistance

Budget: $5,000

Duration: 12 to 24 months

Objective: Provide consulting support to assist in expected early management problems is not available or if the project has not advanced satisfactorily through Phase II, the center may elect to discontinue its sponsorship. Either a full or a partial return of equity to the inventor would then take place.

Phase IV, New Enterprise Development, is the most important and intensive portion of the business development program. At its conclusion we expect to have:

1. A commercially ready product.
2. Initial sales commitments either secured or at least close at hand.
3. A sound business concept to support the venture.
4. A well-prepared lead entrepreneur, preferably the inventor, who has made a successful transition, supported by a management team either on board or identified and ready to come on board upon provision of start-up capital.
5. A thoroughly detailed business plan which will articulate the project for successive investors or lenders.

Given the above conditions we believe the project will be prepared to succeed in the search for venture capital which will follow and in which the innovation center actively participates. We find that the credibility of the university and the innovation center is very useful in attracting the attention of investors and lenders generally. This seems especially to be the case with venture capital firms located principally away from Salt Lake City and preoccupied with the many locally-oriented investment proposals they receive.

The center anticipates that follow-up management assistance will be useful to the ventures we help launch. The center will hold a board seat to represent the stock retained by the university and remain in touch with the company. We also believe that assistance through the university's Small Business Development Center will be useful in the early years of the firm.

Conclusions

Numerous financial groups, including the venture capital firms, have concluded that seed stage investments are so fraught with risk that they constitute an unsound business proposition.[6] Yet it seems clear that such investment is critically necessary to provide an adequate stream of technologically dynamic companies for the economy. But, without a way to screen projects, prepare them adequately, systematically reduce exposure and risk, and spread risk over a number of projects, then seed capital may simply be wasted on poorly conceived and managed projects.

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[6] Productivity, Innovation, op. cit.

It is yet too early to provide definitive data indicating success. However, we are encouraged by our early results and we believe that the innovation center provides the means by which sound seed investments can be made in new technological ventures.

We hypothesize now that necessary and sufficient conditions for a successful new technology-based company are the following:

1. A viable product, suited to provide the foundation of a new firm.
2. A capable entrepreneur backed by a good management team.
3. Adequate seed capital to carry the project to first sales.
4. A launching pad program such as the innovation center which will provide cost effective technical, management and overhead support during the founding period.

The continuing conduct of the innovation center program will test this hypothesis.

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Mr. **Gore**. Thank you very much. I have a few questions and then I want to turn to our panel of expert questioners.

Mr. Tibbetts, your program has been so well received by the small business community. It appears to promote technological innovation at little or no cost to the Government. There is a difference between little and no cost. I would like to ask you what the funding levels have been since 1977?

Mr. **Tibbetts**. It had $1 million in 1977. This was increased to about $3 million for the next 3 years or so. As a result of the domestic policy review, we received a temporary $10 million increase, but the budget cut reduced that before it was applicable. When our 1981 solicitation came out it was based upon the $13 million budget, but unfortunately, by the time we were ready to make the awards, the budget had been reduced both in the previous administration and this administration. It is currently at $4.5 million of new obligation authority.

Mr. **Gore**. $4.5 million?

Mr. **Tibbetts**. Yes.

Mr. **Gore**. It was down from the brief high point of $13 million?

Mr. **Tibbetts**. We never received the $13 million.

Mr. **Gore**. The highest actual funding level was what?

Mr. **Tibbetts**. $4.5 million.

Mr. **Gore**. What about fiscal year 1982?

Mr. **Tibbetts**. It is $5 million.

Mr. **Gore**. So you will get a slight increase?

Mr. **Tibbetts**. Yes.

Mr. **Gore**. You have received approximately 2,000 proposals, and out of those, awards have been made to 200 or 10 percent. Is that a pretty reliable figure?

Mr. **Tibbetts**. Yes; we have been making one out of eight or one out of nine awards. We are scheduled for 80 awards in September from phase I of the 1981 solicitation, and a few others also—about 12—phase II awards. So we will be increasing the percentage slightly.

It is interesting that in the first solicitation, in 1977, we received 329 proposals and made 42 awards. That was an 8-to-1 ratio. When we increased the estimated awards and stated that in the solication the following year, "we anticipate 50 awards," the number of proposals went up similarly; and we also had an 8-to-1 ratio. The same thing happened the next time, and the next time.

The most recent solicitation has gone to a 9-to-1 ratio. We received about 700 roposals.

Mr. **Gore**. That is quite interesting.

How do you explain the fact that the NBS/DOE program funds only 1.3 percent, as opposed to your 10 percent?

Mr. **Tibbetts**. I think they are very different programs. This program is funding research in regular NSF program areas of interest. The NBS/DOE program, I believe, is evaluating inventions. And I think there is quite a difference.

Mr. **Gore**. That makes sense.

Under your program, you plan on making phase II awards to approximately half of the phase I winners. Is that correct?

Mr. TIBBETTS. That was the plan. The funding levels will not allow that at the current time; we will have to reduce phase II awards and stretch them out.

Mr. GORE. What funding level was the 50-percent figure based on?

Mr. TIBBETTS. That was, again, when we had the $13 million budget. The phase I and phase II awards at the planned level would take about $10 or $11 million.

Mr. GORE. I see. At the current funding level, how many phase II awards are planned?

Mr. TIBBETTS. About 12 to 15.

Mr. GORE. Out of 80, 12 to 15?

Mr. TIBBETTS. Phase I occurs one year, and phase II the following, therefore 12 to 15 out of 62 from the previous year.

Mr. GORE. How much of your budget is set aside for evaluation?

Mr. TIBBETTS. We don't have a budget for evaluation. We have a separate unit of the industrial science and technological innovation division, and they are conducting, with their own budget, the beginnings of an evaluation of the program.

Mr. GORE. I mean the evaluation of the proposals you have received, in order to determine the ones who get funded.

Mr. TIBBETTS. It is done though the regular NSF peer review process, with no additional cost other than the administrative cost of sending them out. University and government people do most of the evaluations.

Mr. GORE. You don't break that out as a separate budget item?

Mr. TIBBETTS. No; and we don't pay the reviewers, either.

Mr. GORE. Why do they do it?

Mr. TIBBETTS. Because they are interested, I think, in what is going on at NSF. That constituency, particularly the university people, are, for the most part, people who have research with the foundation, or have had in the past, or look forward to it in the future.

I think it also enables them to stay up with what is going on in the field they are interested in. So we are pleased that they continue to be willing to do that.

Mr. GORE. How large is the total staff engaged in supporting the NSF/SBIR program?

Mr. TIBBETTS. Directly, two program managers, myself and Mr. Coryell, a secretary, and a student aid, part time.

Mr. GORE. That is pretty interesting, very interesting.

Dr. Brown, the Utah Innovations Center assists inventers or small firms at an early stage, so they can qualify for follow-on venture capital. It is my understanding that you have screened over 1,000 proposals, and have found only 20 of those to merit your assistance. Is that correct?

Dr. BROWN. By and large, that is correct. We probably would seriously consider more if we had more space and facilities. As a practical matter, we do become very selective in picking those that we think are the best possibilities. We discard many because they do not have the technological content that we would like to see. It is a highly selective process.

Mr. GORE. I bet you get some interesting proposals.

Dr. **Brown**. Yes. We have. We have many that violate the laws of thermodynamics, which we tend to discard.

Mr. **Gore**. Laws of what?

Dr. **Brown**. Thermodynamics—the first and second laws of thermodynamics.

Mr. **Gore**. That is a problem.

Dr. **Brown**. We tend to discourage those people quickly.

Mr. **Gore**. I have some of those proposals come into my office, also.

Dr. **Brown**. We look to people——

Mr. **Gore**. Not from the staff. [Laughter.]

From entrepreneurs.

Dr. **Brown**. If we are dealing with a technical concept, we generally seek an individual who has technical background—education or work experience commensurate with the thing he is trying to do. Often we find ideas come from people who have very little background, trying to do something extremely technical.

Mr. **Gore**. Are you interested in receiving some more of those? [Laughter.]

I occasionally need a place to refer.

Dr. **Brown**. We had an interesting one from a prison inmate in Texas, who subsequently threatened to get us, when he got out.

Mr. **Gore**. He was not 1 of the 20?

Dr. **Brown**. You're correct.

Mr. **Gore**. Now, on a more serious note, does your program assist entrepreneurs from all parts of the country, or just from Utah, or just from your region?

Dr. **Brown**. We have no policy that precludes work on a national basis. However, the way we operate tends to work better with people who are willing to move into our facilities. We really do a lot of hands-on counseling. It is difficult to do that by mail or telephone.

We have dealt with one inventor in Connecticut, to try to develop his technology at the center. That didn't work very well. We have done better when we have helped somebody else, rather than using our own staff to do the development. We really prefer to be an assister, and find somebody that we really think has the spark and ingenuity to do something, and say, let's help you. We are not a development center, per se.

Mr. **Gore**. Could your program or a program like yours be expanded to assist others in less depth—for example, by simply assisting in market analysis, or preparing a business plan?

Dr. **Brown**. There have been a number of programs which have attempted to achieve this. We go a little bit further than that, and that is one of the reasons, I think, that we have some success. It is more than just a couple of hours' counseling; there is a very intimate relationship we develop, by moving a person into our facilities. And I think that is the key to it.

We ask for equity and the equity position enables us to get the person's attention. He knows we are serious, and we know he is serious if we get that far. But secondly, it provides an ongoing form of revenue, if it is successful.

Mr. **Gore**. You wouldn't really recommend the approach presumed in my earlier question?

Dr. BROWN. I think there is a place for those types of counseling groups but I think the more in-depth approach is more effective. I also believe it is economical in terms of the eventual returns.

Mr. GORE. All right. Is NSF your only source of funding?

Dr. BROWN. About 99.8 percent.

Mr. GORE. What is the cost of running the center?

Dr. BROWN. Our budget from NSF has averaged between $250,000 and $300,000 over the past 2½ years.

Mr. GORE. That is an annual figure?

Dr. BROWN. That is an annual figure.

Mr. GORE. And 99 percent of the total is coming from NSF?

Dr. BROWN. That's correct.

Mr. GORE. Is that going to continue?

Dr. BROWN. From what NSF tells us, no. We have been given our final funding allocation, and they say unless something happens in the program, that is all the money there is going to be.

Mr. GORE. That is too bad.

When would it stop?

Dr. BROWN. We have been trying to figure out recently how to stretch our budget, and we think we can last through about July 1, 1982, by curtailing some of the services we have been willing to render. It causes a difficulty because, at this point, the staff begins to look around to other opportunities.

Mr. GORE. Yes. All right.

I would now like to introduce for the record our special panelists, and invite them to direct questions to Mr. Tibbetts and Dr. Brown.

Jacob Rabinow, presently chief research engineer at NBS. He has worked at other Federal labs, and with Control Data, from whom we heard yesterday. He has received 216 patents.

Mr. RABINOW. In the United States.

Mr. GORE. In the United States alone, in his distinguished career, ranging from a safety device for missiles to a letter-sorting system for the U.S. Postal Service. I——

Mr. RABINOW. Don't blame me for what is happening with the Postal Service.

Mr. GORE. OK. That will not locate the hex advertising mail outs quickly, will it?

Mr. RABINOW. No comment.

Mr. GORE. He was selected for the 1980 Scientist of the Year Award by the Industrial Research and Development magazine.

Stanley Mason is president of Simco, Inc. He has developed a process whereby the seeds from the Chinese tallow tree can be crushed, to develop a fuel that can be used in a diesel engine, without additional processing or refining. We may be hearing a great deal more about that. He estimates it would replace 5 percent of the petroleum used in this country. Also, part of the seed can be used as a substitute for edible fats. The oil can be used in the manufacture of plastics.

Mr. Mason has worked for United States Steel, Armstrong, Modern Aircraft Tool, Hunt & Wesson, and American Can. He now owns three companies himself.

Dr. John Easton, Ph.D. in crop physiology from Purdue, has worked extensively in the agronomy field. He has developed a process that taken anhydrous ammonia and chemically converts it to ammonium nitrate solution, which is its most valuable and efficient form—again, a process about which we may be hearing a great deal in the future. This process may reduce the total nitrogen cost for the average farm by 40 to 45 percent. It has implications not only in this country, but around the world.

Richard Reed is an inventor who submitted a proposal to OERI for a modified two-cycle engine. He has a long and well documented experience with the OERI program. We will get into a summary of his involvement with OERI a little later, when they appear.

I guess we could start with you, Mr. Rabinow, and just go in order. Please proceed.

Mr. RABINOW. Before I ask the questions, you raised a point, Mr. Gore, about the percentages of good inventions from the wheat and the chaff that we get in Government and industry.

I was executive director of the National Inventors Council, which was an organization that existed from 1941 to 1974. It had a lot of good help, which was also free, Mr. Tibbetts. Apparently, the less you pay people, the better the quality of help. We had three Nobel prizewinners. We had nearly all of the great inventors, at one time or another, serving on it—people like Carlson of Xerox.

Over the years, we evaluated 625,000 submissions—over a half a million—and maybe less than a few dozen were any good. One of them did become a billion-dollar business. Our job was not to hand out money. We would only evaluate things. I was the last executive director, which means I did the paperwork. Dr. Draper was the last chairman of the Council; Kettering was the first.

We would recommend the inventions to different Government agencies if we liked them. During the war, we had as many as 28 people, evaluating these things. The percentage of promising ideas was much, much less than 1 percent. The submissions depend on the announcement that you make, and what sort of people you attract.

We had perpetual motion machines by the dozen, as the Bureau gets now. Although I have a title that says I am the chief research engineer of the National Bureau of Standards, I work there only about 12 or 15 hours a week as a consultant, because I am partly retired. Also, I have to disqualify myself, if I have to ask questions of Mr. Lewett, who will be testifying later.

I have been involved with inventors all over the world, and it is not unusual, when you announce that you are going to support inventors, that you get a great deal of flack because you turn down most of them.

I would like to ask Mr. Tibbetts that when he talks about NSF objectives, does that immediately limit the type of submissions that they get?

And when you say "solicitations," do you tell people what sort of inventions you are going to prefer, what sort of research you prefer?

Mr. TIBBETTS. Yes. We indicate this, as in the topics I read off right in the beginning.

Mr. RABINOW. But do you tell them what sort of things you want? What you would not consider, for example?

Mr. TIBBETTS. Yes. Essentially, the proposals submitted must be for advanced research, and must be on the subjects that we list in the solicitation.

Mr. RABINOW. That automatically raises the quality, I imagine, immediately?

Mr. TIBBETTS. I don't know if it raises the quality.

Mr. RABINOW. Obviously, it does, because you certainly get a much higher percentage of things you like than anybody who ever worked with this.

Mr. TIBBETTS. When we say "research," I think automatically——

Mr. RABINOW. It scares away the inventor?

Mr. TIBBETTS. I think it scares away many inventors. And also, I think the track record shows, as time goes on, where people submit and lose in one or two solicitations, they may not submit any more. Those who have won may submit more than one proposal. We know of one firm that has won about 6 times that submitted 10 proposals in different topic areas in the most recent solicitation.

Mr. RABINOW. The other question is about the amount of money you hand out. Phase I is $30,000, you said?

Mr. TIBBETTS. Yes, sir. It originally was $25,000.

Mr. RABINOW. That is very little money for a company. It is less than the salary of one secretary, with overhead, for example.

Does that mean they really want the $30,000 as a wedge in the door, so they can get the second phase money?

Mr. TIBBETTS. Yes. From our point of view, we are trying to find out whether they can do quality research, based on that small look. We are trying to find out their capabilities, and whether the idea has technical feasibility. The real situation—the reason for that decision was that initially, I had $1 million. We had a choice of, let's say, 10 awards at $100,000 or 100 awards at $10,000. We felt the $10,000 was a little too small, but you need a lot of awards, if you look at the size of the audience out there, as well as for technological innovation. So we settled on 40 at $25,000.

Mr. GORE. May I interrupt, Mr. Rabinow?

Have you found any cases where the phase I award has been used as a kind of validation?

Mr. TIBBETTS. Yes.

Mr. GORE. Enabling the individual to go out to the venture capital market, and say, "look here, the Federal Government has given me $30,000; that is an indication I have got something here."

Mr. TIBBETTS. I have had a number of people call me and, with great pride, tell me that:

> You turned us down in phase II, but we want to tell you that we got another $250,000 anyhow. But we also want to thank you, because it was based on the fact that you funded phase I, and provided the discipline and the approach and the proposal, and the fact that NSF thought well enough to fund it in phase I did make a significant difference in getting the funding.

I know of three proposals in the latest solicitation in phase I that have follow-on funding attached to them right now.

In one case, it is way up there. A firm has the potential—has a commitment for a follow-on $2 million if we fund phase I. And of course I asked the question: "Well, if you can get $2 million from a firm, why in the world are they concerned about $30,000."

And they literally said that the investor does not have the ability to evaluate the technology. They probably could evaluate it elsewhere, but they have great confidence in NSF's taking a look at it. And he does have that kind of a commitment for funding.

Mr. RABINOW. One more simple question.

What about patent rights? Do you let them keep them?

Mr. TIBBETTS. Patent rights, from the beginning, have been available to the small firm for commercial purposes, but with a contingency, originally which said, contingent upon their getting follow-on capital to pursue commercialization in phase III.

Mr. RABINOW. If they don't?

Mr. TIBBETTS. Then we may not give them patent rights.

Mr. RABINOW. The question I have for Mr. Brown is: You say you are very selective. Does that mean that you have to go through a lot of chaff to select the wheat?

Dr. BROWN. That is correct.

Mr. RABINOW. Who does that?

Dr. BROWN. We start with our normal evaluations in the center, with some of our staff, and progressively increase to the point where, generally when I see the thing, it is a pretty good idea, and they recommend it to me.

Mr. RABINOW. Do you get much flack from the ones you turn down?

Dr. BROWN. Some. There is always a great deal of disappointment. Comments such as "You would not fund Thomas Edison if he walked in the door," and so on.

Mr. RABINOW. Probably would not. [Laughter.]

Dr. BROWN. Perhaps. But I don't think he ever did anything that violated the first and second laws of thermodynamics.

Could I comment on your previous question about the $30,000. I don't think we should belittle $30,000 to a startup situation.

Mr. RABINOW. I do not belittle $30,000. But the companies that were mentioned can certainly spend $30,000 of their own. That is the question I raised.

Dr. BROWN. Let me talk about the startup, the guy who has already got a job. He is doing this part time. He has no overhead. He is using his wife's kitchen for some of the experiments, and so forth; $30,000 in that place goes a long way.

The people we are trying to bring into the center, they are just delighted if they can get $30,000; and we are delighted because we can provide the overhead facilities. What they need is some money to buy technical support or equipment and supplies. Seldom does that kind of money go into salaries.

Mr. TIBBETTS. I have asked many of the firms about why didn't they fund this themselves. And generally, they will say: "We do fund some that we have—where the risk is low enough to fund, and we use all of our money that way. But when we get into very high risks——"

Mr. RABINOW. Then they come to the Government?

Mr. TIBBETTS. Yes. Then they try to get initially funded here.

Mr. GORE. Mr. Eastin?

Dr. EASTIN. I would like to comment first before I ask the question on the $30,000 matter. I have negotiated with a large number of firms on the particular invention that I am involved with. The approach that was—I always ran into, if the company was someone who had a technology base in the area that I was involved in, we simply could not come to an agreement on the confidential disclosure agreements. There is no yo-yo farmer out there that has been able to develop technology. DuPont is an example.

I had an opportunity to meet with one of the executives in DuPont because of a personal friend connection, but he simply told me that they were spending $10 million a year on nitrogen research, so there was no way you could, as a farmer in western Nebraska—you can do anything that we don't know.

The same reaction was obtained from Swift. It happened to be that I bought from Monsanto a piece of equipment, and in order to sell that piece of equipment to the Biochem Division—had to sign a confidential disclosure agreement with them. Well, their chemical engineer came and looked at me and said, "My God, we'd better look at that." But the division, the fertilizer division, which should have been concerned about it—their legal staff—they are in a system; they are in a bureaucracy. It is necessary probably for a certain kind of business, but in general, I feel it tends to stifle innovation on an individual basis to go to a large firm.

They evaluated the invention. They hired consultants. They did not have an expertise in this particular area, but they are interested in the agricultural market. It came down to whether they would provide $200,000 in a contract for finishing up the development work on it, and the manager of new product development said simply, "I do not believe I can afford to hang myself out for $200,000." He said, "I make a decision. You get it on the market, and I will spend several million, because the market potential looks great, but, you know, I don't want to take a chance on my job."

I think this comes back to the technical evaluation thing. The Center for Innovation provided me with $12,000. There is over $600,000 spent on the project of my own money, and I was out, you know—I was ready to go under. But that little bit of support brought some business involvement in that.

Mr. GORE. It gave you some confidence.

Dr. EASTIN. I had the confidence. Inventors always have confidence. They don't know any better.

I think this kind of program—seed money—there is no such thing as venture capital. It is not venture capital. They are market development people. They just like to say "venture." If you can put it in the marketplace, you don't need their venture capital. My gosh—and that's what they want—all of the types of money that is available for this sort of thing. There is no place in—I'm getting off on a lecture.

Mr. GORE. It's fine. It's very informative.

Dr. EASTIN. I came to Washington last summer because I felt that this thing has tremendous energy implications. I was told by all of the experts in DOE and OERI and so on that, "Hey, we don't have a charter for this sort of thing."

Well, we can fund a biomass harvester or we can do this or we can do that, but go talk to Kelso and conservation. Go talk to Roland Tibbetts. I was referred to him. I was referred to all kinds of people. And I can go down the same list that I imagine you have. I have got the list, and you are welcome to it.

All of these people are sitting like Frank Bauer at DeKalb Ag research within a bureaucracy where it is geared to work with firms—large firms, not individual innovators. I was specifically told by the conservation people in DOE, "If you can get Battelle to evaluate it, then. we will look at it. We will try and fit it in somewhere."

So I went to Battelle. Battelle looked at it. Mr. Ekins from Battelle said, "Well, Mr. Eastin, what you need to do is, you need to submit a proposal to evaluate it at DOE, and they will give you probably $20,000 to $25,000 to evaluate."

Well, they are used to that. They submit consulting proposals, and they get funded. A man from TRW told me the same thing. "You should get $20,000 or $25,000 just to evaluate your proposal. Don't ask for support. Ask for money to evaluate it." That is the kind of system you have got. And you know, it was really discouraging.

I was told by people in the DOE office, in the contracts office, "Go back and become a university professor again. You are not credible as an individual, but if you will get us a structure that we put money through—have put it through before such as Battelle or such as the university, then we can fund you. Your proposal sounds OK."

And I said, "But it will cost 50 percent more."

"It doesn't matter. We have a structure that we can work with, and we can pass the report up the line. We were specifically told that we can pass it on. And our managers know that it is a credible thing to work with."

That is why I'm here today at my own expense. Something needs to be done.

Mr. GORE. OK.

Dr. EASTIN. I would like to ask a question.

Mr. GORE. Sure.

Dr. EASTIN. When I talked to you earlier, my proposal was too far along. There was research to be done, but it was considered as a development proposal and not as a research proposal.

Do you have a program for development proposals?

Mr. TIBBETTS. No. The NSF's charter is strictly to fund research. If a proposal is judged to be principally development, we do not continue the evaluation of the proposal. That is not true of other agencies.

Dr. EASTIN. Mr. Brown, you are geared more to the development phase, as I understand it.

Dr. BROWN. That's correct.

Dr. EASTIN. I would just like to say that something in the development phase——

Mr. GORE. If he had come to you, conceivably you could have short circuited the process.

Dr. BROWN. I'm not completely familiar with what he is doing, but we have had some favorable experiences with things of an agronomy nature in our center, and we would have been very excited about it, if it looked like it was new and innovative.

Mr. GORE. That is the one that is being stopped.

Dr. Eastin. Yes, I understand that. I would like to comment, but I don't know what it would do.

Mr. Gore. Thank you, Mr. Eastin. That is exactly the kind of perspective that we were hoping the panel would provide.

Dr. Eastin. I can say that I submitted the thing—OERI is not up yet; I will wait until later. [Laughter.]

Mr. Gore. They will be waiting for that, I am sure.

Mr. Tibbetts. Could I make a brief response?

Many of the companies you mentioned, as well as dozens and dozens more, are extremely interested in phase III operations with us, including looking at the losers, so we are changing the process. In the past, they have only had a shot at the winners—say, one out of eight or nine—and they want to look at the losers because they want to do their own evaluation. That is a litte bit of a different twist.

Relative to Dr. Eastin's remarks on private investment, one firm that has received $9 million of private capital in the SBIR program was in chapter 11 when we made our award. The fact that we made the award and they were successful with the research in that small proposal immediately got them another $500,000, which I did not know at the time. Then when they got their phase II award from us—this was additional credibility—they got another $3 million from a venture capital firm. And this took them right out of chapter 11. And now, while school is still out on whether this high risk effort will work, it looks very promising. In fact, the venture capital firm, which was a big winner in the Amdahl computer investment, feels that this may have more potential than their investment in Amdahl. And that was from a chapter 11 start. The additional $30,000 turned that around—actually $25,000 turned that around.

Dr. Eastin. The evaluation is critical. Whether they are competent or not, it means something.

Mr. Gore. Thank you. Mr. Reed?

Mr. Reed. I will not do anything except say, my experience largely concurs with what Mr. Eastin has experienced. And Mr. Eastin and I have three files approximately 2 or 3 inches thick each./One of the things I was interested in—I recognize that your funding of advanced research—somewhere between 10 and, say, 12 or 14 percent of all requests are funded.

What kind of attitude does the remaining majority have toward the rejection.

Mr. Tibbetts. It has been 99-percent understanding. They particularly recognize the odds when they submit—we tell them the odds going in, as a matter of fact. Only once in awhile will I get a disgruntled person. So it is not a problem.

Mr. Reed. There must be some reason outside of the fact that you are dealing with, say, more competent and higher caliber of people. It must say something about the way you respond where the decision is negative. Do you give them an adequate explanation, adequate technical information describing why you rejected it?

Mr. Tibbetts. We try to. I don't think we do a good enough job. We are trying to improve that. We will have better responses than we have ever had on why a proposal was turned down in this fourth solicitation.

I would say we were unable to give sufficient information, I think, in the past.

Mr. REED. All right. My next question goes out—you have already said that you have one company who wants to take a look at those.

Mr. TIBBETTS. Many want to take a look.

Mr. REED. The ones whose requests were declined. I'm wondering, what sort of a history are you having with this geat majority who are declined?

Mr. TIBBETTS. The Foundation's rules are that no one can look at a declined proposal. A successful proposal where public funds are spent becomes public information, except for any proprietary, critical paragraphs that we do allow them to excise from publication. We allow them to delay publication until they have a patent entered. But we are trying. Would you go back to your question briefly?

Mr. REED. I was just interested in what sort of reaction you had to the negative responses.

Mr. TIBBETTS. Yes. The reaction is, we would like to get any other possible source of funding, and we changed the latest solicitation to say, "Will you allow us to disclose the title of your proposal, even though you may lose, to outside parties," and the firms—I would say 98 percent of the firms have said yes. And the large firms, from Monsanto to Exxon to what have you, all want to look at those, and then they will contact the small firm directly and ask whether or not the firm is willing to disclose to them—the Government is out of the loop at that point.

Mr. REED. Is there a point in some cases where there are some questions that are unresolved, that predict a negative response, where you give the submitter an opportunity to clear up those ambiguities or negative points?

Mr. TIBBETTS. In a competitive situation, we are not allowed to go back and forth with the proposer. And we also would have difficulty doing it based on the volume and the staff that we had. In the unsolicited proposal area at the Foundation, that kind of backing and forthing does take place.

Mr. REED. I see. Thank you.

Mr. GORE. Thank you. Mr. Mason?

Mr. MASON. Thank you. This is very, very interesting, and it is right where I live. I have not always been in this innovation business as an individual. I have a history of working, having had jobs of all kinds with a whole series of large companies. In some of these companies, I've held important positions such as vice president of product development with a large number of laboratory people reporting to me. Between these jobs—have set up small companies and had them prosper or fail, as they will.

The core of all of the things we are talking about is that there really are several different kinds of people: certain kinds group in large companies. They seem to be the same. At one time these large companies were small companies started by innovators. As they became successful, they needed to protect what they have gained. And now as they have become rich and large, the bankers are now running them. The innovators are either under control or outside. (Parenthetically, it helps to be tall and handsome if you're in a big company.) It helps not to be an intuitive decisionmaker. It helps not to take risks; because you should not risk the company's money without numerical data, and lots of it.

This is really what Mr. Tibbetts is doing here and the National Science Foundation. He is helping people who have an idea to get legitimate. That is what I saw in the National Science Foundation's support of our Chinese tallow project.

Some background. One of the companies with whom I am associated, works half of its time on inventions for itself and half of the time for large companies. Companies such as American Can, Hunt-Wesson, Frito-Lay, and a whole series of other companies. These companies were all very interested in our Chinese tallow project because the wax and oils from this plant can be used for food or it can be used for fuel for diesel engines. It can be used for making plastics and so forth and so on. The program is seen to be, potentially, a very profitable operation. The Chinese tallow plant is not new; it has been in cultivation for centuries. It just seems new in America, although it was brought here in the 1700's and again in the 1920's. It went wild in Texas and has spread throughout the gulf coastal region.

It is important, to note that none of these companies would support the project, basically because the tallow plant is a tree, not an annual. Nature cannot be hurried up. It takes 5 years before you get some useful oil-bearing seeds, whereas most of the policies of these companies require the return on investment in 2 years, so it was impossible for such organizations to commit dollars. It is a problem, you see. And so the conservative people who are running all of these companies with which we talked said, "It sounds nice, but we really don't believe it." And you know there is the "it is not invented here" syndrome on the inside of some large companies. They seem sure that somebody outside the company is not quite as bright because they have not the "security" or the "protection" of the inside, you see. They really don't know.

In any event, we learned about the National Science Foundation small business innovation program. As a matter of fact, they heard about us (which I thought was an extremely innovative thing on their part). We put together a proposal to organize the development of the Chinese tallow tree; it had many parts to it. It was very complex. It was a very good bit of scientific planning. We were awarded a phase I grant of $25,000. We actually put more than $25,000 of our funds in addition, to make the work very, very good.

We never would have become so well organized if we did not have the incentive of the NSF grant. The $25,000 were very good dollars and they spent very well. But the important thing that I think happened, the moment we got the award was that we "became legitimate", and now people talk with us. And they say, "Oh, you really have good science here." So that is the important thing.

I have a couple of questions. One, "how do you increase and how do you multiply what the NSF is doing?" The question is how well are they doing it, but, how can the program be expanded? That is the important issue.

The question is, how big can it be, and how can you promote it so people like myself know that it is going on? I don't think there is really anywhere near enough broad knowledge of the program. That is a question for Mr. Tibbetts, the other question is for Dr. Brown.

Have you localized this program? Could it be localized? Could it be in small towns or wherever the university is?

Those are my questions.

Mr. TIBBETTS. I am afraid an agency cannot lobby for its own——

Mr. MASON. I don't think this is lobbying; it is information.

Mr. TIBBETTS. I think it amounts to that. I don't think we can do that kind of expansion of the program. We will do as much as our budget allows, and that is what we have been doing.

Mr. RABINOW. Mr. Mason can lobby for you, however.

Mr. GORE. The members of the Subcommittee can, too.

At the conclusion of these hearings, we will have findings of the subcommittee. And based on the testimony we have been hearing, it is fair to conclude that this program stands out as a remarkable success. With two people and a secretary, they have achieved fantastic results.

Mr. TIBBETTS. Let me not misrepresent, though. We have 22 topics in this solicitation, and there are 22 program managers in NSF who, in their regular fields—let's say a man whose field is chemistry—he will get the chemistry topic proposals to manage, and that is part of his regular job.

I devote my time fully to this program; the other people do not. So there is a lot of help beyond just the two of us. It is part of the regular review of proposals.

Mr. GORE. Focusing Mr. Mason's question, would it be possible to scale up the program that you have if the Congress decided to do so? Would that ruin it if it was scaled up? Or could it be?

Mr. TIBBETTS. I would answer this way. Simply, as we have increased the number of anticipated Phase I awards, they have gone from 40 to 80, the number of proposals received has gone from 300 to 700, and I have no reason to believe that this would not continue. I would also say that the average quality is higher in the 700 than it was in the 300. So people are learning how to do it.

I do think that there is a potential to expand. As you may know, the Defense Department has initiated a similar program, although they don't have the emphasis on Phase III for commercialization. Their Phase III has greater emphasis on the follow-on production possibilities for Defense Department use. It is modeled after the NSF/SAIR program, and it is on a scale approximately four times the size of ours but to meet their own requirements.

Mr. GORE. But with respect to your program, at what point would the structure become overloaded. These 22 people obviously play a key role, and your reviewers who are unpaid, they play a key role. At what point would those two elements of the system become overloaded?

Mr. TIBBETTS. I don't know, Mr. Chairman. I do not think we are there as yet. Some people in the Foundation may give a different answer. The Foundation uses about 25,000 reviewers of their proposals regularly. We are using relatively few of those.

Mr. RABINOW. How many proposals do you get for the whole National Science Foundation, outside of your program?

Mr. TIBBETTS. I think——

Mr. RABINOW. There must be thousands.

Mr. TIBBETTS. I think it is in the vicinity of 18,000 a year, if I recall correctly. The Foundation gets an awful lot of proposals outside of this program. This is a very small program in the National Science Foundation.

Mr. GORE. Yes.

Dr. EASTIN. Your success rate on these things has to do not in small part with the nature of the people that your solicitation gets to, I'm sure. Your 10 percent versus 1 percent is determined, I would say, in large measure by that.

You are again at a different level, Mr. Brown. You are out where you have exposure on an individual basis to—you almost have to be in the technical community to know about the National Science Foundation.

Dr. BROWN. We encourage people who come to us to apply to this program because we think it makes a lot of sense. I think it is one of the better things that our Government has done in this whole area.

The only thing I keep saying is that inventors need additional help such as innovation centers can provide, particularly for brand new start-ups. I think it is a very effective program. Two firms with which I am involved have received grants from the program, and both have used them very effectively. We have encouraged firms in the Innovation Center to apply. So I have seen the program from both sides. I think it is an extremely effective program and should be expanded to essentially all of the Government agencies who are spending R. & D. funds.

Mr. GORE. Mr. Mason, did you have other questions?

Mr. MASON. That was all. Thank you.

Mr. GORE. Let me ask one final question. We have uncovered the importance of the validation aspect of your phase I award. Should that lead us to conclude that a scale-up of your program in the future ought to focus more on an expansion of the phase I—the size of the phase I program and less on an expansion of the phase II award?

It is my understanding that the aborted scale-up to $13 million allocated a good portion of the additional funds to the phase II part of the program. I am wondering if we might have more success in scaling up the phase I part of the program.

Mr. TIBBETTS. Mr. Chairman, in talking with many of these firms, they are not bidding for a $25,000 or $30,000 award; they are bidding for a $200,000 award in phase II. And if we did not have—my own estimate would be at least one-third in phase I resulting in phase II awards. I think the number of firms, particularly of quality firms, interested in the program would fall off.

Mr. GORE. You have to keep that proportion. You have to keep some bait in the bucket, so to speak?

Mr. TIBBETTS. That is my judgment.

Dr. EASTIN. There is another aspect. I only very recently saw your solicitation, and I thought it was interesting in that it does provide the second phase. But more importantly than that money that is in the second phase, it requires that inventor or a technologically minded person to pursue the thought himself of that assistance where you are asking him to come up with a plan for outside assistance at the moment he applies for the $30,000, and that is part of the basis upon which that award is made.

I think that is an important step for an inventor. Being involved in that myself, I know what a loathsome task it is to think about anything other than doing technological innovation. And it is such a critical part. Hindsight is great.

Mr. TIBBETTS. One final comment on your question. The phase I proposals, the large number we get, is an administrative burden. When you try to review 700 proposals, that is a lot of effort. That was intended to be a screening effort to rapidly get the large number down to a much more manageable number. The plan was that 80 percent of the funding would go out in phase II where we were going to deal with a very limited number of proposals, like the phase I winners only, so we are immediately dealing with one-eighth or one-ninth of the number of proposers with phase II, full-size award proposals.

Now I should say, too, that the phase I proposal is very small. It is intended to be only 20 pages with cover and budget, everything. The phase II proposal is, in a sense, a regular-size proposal because the Foundation normally will require more than seven pages of proposal meat, to make a $200,000 award. We do not want to ask for full-size proposals from 700 parties. We cannot afford the review time in the Foundation. So we want to get the number down to a smaller number with the screening out in phase I. And therefore I would think we have to have some balance between the number of phase I and phase II awards as in the interest of getting quality proposals.

Mr. GORE. That is very helpful, and we may, after deliberations as a subcommittee, recommend a scaling up of your program, but we do not want to ruin your success. We want to try to identify any problems that might be encountered by scaling it up in this proportion which must remain between phase I and phase II, which may be an important element of the potential overload on these bottleneck review aspects. That may be a problem also, but we will consider that.

Dr. Brown, you had something else to say?

Dr. BROWN. I want to make one comment in response to Mr. Mason's question about the role of universities in such things as we do. Any first rate university has a magnificent array of talent. You can find one of every kind of expert and one of every kind of piece of research apparatus that exists.

What we try to do is use that talent in our evaluation process. We have a lot of people who come to us with ideas that we do not know how to evaluate. Just as Owen does, we get faculty colleagues that we trust and perhaps owe us some favors or something to give us some assistance. There is a great deal of information that can be achieved in the universities if people know how to do it on a free basis. After all, they are primarily public institutions. They have been sponsored by taxpayers. It is only fair that the public gets some information back.

We try to rely on that very heavily and we do a lot of things on a free basis. Most universities are quite willing to provide such service.

Mr. GORE. For the others, maybe we could establish a one-person National Institute of Thermodynamics where you could quickly refer a lot of the other proposals, so as to separate the wheat from the chaff early. [Laughter.]

Thank you very much, both of you. We are going to go to the second panel, but before we do, there is a vote on the floor, and this is a natural breaking point. We will recess for no more than 10 minutes and come back and take the second panel.

[Recess.]

Mr. GORE. The subcommittee will come to order, and we are moving into our second panel: Donald Templeman, Deputy Administrator of the Small Business Administration will lead off; Dr. Andy Luff, a former entrepreneur who conducted a study on the SBA innovation centers; Robert F. Zicarelli, chairman, of Northwest Growth Fund, Inc., an SBA SBIC. He deals with early-stage financing, and he helped found Control Data and Memorex.

Without objection, your entire prepared statements will be put into the record, gentlemen, and we will invite you to proceed with your oral presentations, beginning with you, Mr. Templeman.

STATEMENT OF DONALD TEMPLEMAN, DEPUTY ADMINISTRATOR, SMALL BUSINESS ADMINISTRATION

Mr. TEMPLEMAN. Thank you, Mr. Chairman.

I am pleased to have the opportunity to appear before you this morning to discuss SBA's programs to assist small, high-technology firms and inventors. I would like to compliment the committee on their foresight in holding these hearings, because obviously this is an area that really needs to be investigated, and we welcome our participation.

For approximately the last two decades, the United States has been faced with increasing competition, both developed countries and developing countries are flooding our markets. We are experiencing a technology crisis. With small business being the innovator of our economy, we must act now to improve the climate for small business, so that once again we can take a forefront in this innovative technology area.

My remarks today are directed to four areas where SBA is involved in helping small business firms become more effective in high technology. They are the legislation, innovation centers partially funded by SBA, and our procurement and technical assistance that we provide to small businesses as well as our efforts in the Office of Advocacy.

In the last several years, the Federal Government has taken a greater interest in developing solutions to major small business problems than almost any other time in our country's history. This interest was demonstrated by the last Congress in formulating and passing significant pieces of legislation, among them Public Law 96-317, the first patent system reform in many years; Public Law 96-477, the Small Business Investment Incentives Act, the Regulatory Flexibility Act, and the Equal Access to Justice Act, and the

Paperwork Reduction Act. All of these things go toward helping small business in general and certainly high-technology companies.

Earlier this year, Senator Rudman and Congressman Lewis introduced the Small Business Innovation Research Act, which of course is modeled on the innovation program of NSF that Mr. Tibbetts was talking about. We certainly support the concept of small business innovation research and feel that it is a significant way in which Government research needs can be fulfilled while at the same time creating a more fertile environment for the commercial development of small business R. & D.

Turning to the innovation centers, SBA currently funds three such centers through cooperative agreements with a fiscal year 1981 cost of $716,000. We have approximately $700,000 in these kinds of funds for the rest of this year; however, we do not intend to fund these centers again.

The Center for Innovation in Butte, Mont.; the Golden Gate Energy Center in Sausalito, Calif.; the Commercial Credit Management Corp. in Baltimore, Md.—of course, they provide a full range of service, and I'm not going to go into any of those in great detail. Dr. Luff will, I am sure.

There was a study between May 22 and June 12 in the SBA on this experimental program. The two factors of time and risk did not allow a rigorous assessment of this program, although there were instances of positive effects to small business through aid from these centers. SBA feels that the cost is too great, given our reducing resources in the agency.

The innovation concept—center concept—is an interesting experiment, but at this point the experiment simply does not reflect the solid evidence needed to continue the centers with the present environment of reduced agency resources. The average SBA share of the cost of cases handled, of the experiments, is roughly $900 for the Control Data Center, $40,000 for Golden Gate, and $31,000 for the Center for Technology. Given our mission and what our role is in this area, this is simply more of our resources on a fewer number than we feel is appropriate.

The innovation center concept is not in keeping with the Reagan administration's efforts to reduce the growth of Government and limit expenditures wherever possible. Although I certainly recognize that they are of value and have much to offer, it is a matter of putting few resources where they will do the most good.

Moving on to the procurement area, SBA is mandated to conduct a program which would deliver to small business concerns the benefit of research and development performed under Government contracts or Government expense. In addition, the agency is directed to assist small firms in their efforts to obtain Government contracts for research and development. The primary effort is directed toward technology transfer, the identification of the best available technology to assist a small firm in solving a particular problem in improving a process or developing a new product.

One of the most significant efforts that we have in our technology transfer program has been our partnership with selected universities and with the National Aeronautics and Space Administration. We are providing state-of-the-art information to small businesses at a cost of $100 to $200 per case. The results of this program have encouraged us to consider additional sites for expansion because of its cost effectiveness. I believe, in fact, that this is the type of technology assistance center that was intended by Public Law 96-302, rather than the innovation centers, which is the way the line management of SBA chose to use those funds.

We have an interagency agreement with NASA wherein four of the NASA industrial applications centers are jointly funded to assist our officers in some of our regions, and we utilize computerized technology bases, technical experts, and problem-solving capabilities to assist small firms, recognizing that we assist them on a particular problem and we are not in that area—not in the business of business planning or developing a technology to the marketplace necessarily.

In addition to these four centers, we fund a program at the University of Kansas. It is the only one that SBA funds completely. Under that program, under the direction of a senior faculty members and a number of graduate students, we provide assistance again on a case or a problem-by-problem basis for approximately 400 firms a year throughout our region 7, which is Nebraska, Iowa, Kansas, and Missouri.

It is interesting that that yearly effort is about $45,000 for 400 cases, whereas the innovation centers, one of them is nearly $40,000 a case.

The Office of Advocacy in SBA has been actively involved in the innovation area and will continue its efforts to identify the needs of high-technology firms to formulate solutions. For instance, the Office of Economic Research has funded several projects in the last few years which explore the innovation process and the problems entrepreneurs encounter as they establish small, high-technology firms.

As you know, such small-business-related research is sorely needed. Among the studies have been analyses of the role of patents in the commercialization of new technology for small innovative firms, an investigation of the cost availability and market efficiency of informal risk capital, and the relationship between industrial concentration and technological innovation.

In addition, the establishment of our small business data base, which the Congress mandated a couple of years ago, should help us understand the impact of Federal policy on innovation.

In 1979, Advocacy assembled a panel of high-technology firm owners, managers, and venture capitalists. The task force held several meetings and assembled a report which cataloged much of the work in this area.

As I have noted in the prepared testimony, SBA is involved in a number of ways helping small business in high-technology areas. Our intent is to be as helpful to as many firms as possible in keeping with our mandate in the Small Business Act.

The present economic program, as outlined by the administration, directs that SBA must use its funds wisely, so that the greatest assistance can be given to the greatest number of firms.

Mr. Chairman, this concludes my statement. I would be glad to answer any questions.

[The prepared statement of Mr. Templeman follows:]

SBA
U.S. Small Business Administration
Washington, D.C. 20416

STATEMENT OF
DONALD R. TEMPLEMAN, DEPUTY ADMINISTRATOR
U.S. SMALL BUSINESS ADMINISTRATION
BEFORE THE
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

July 22, 1981

MR. CHAIRMAN AND MEMBERS OF THIS SUBCOMMITTEE:

I am pleased to have this opportunity to appear before you to discuss the Small Business Administration's programs that assist small, high technology firms and independent inventors.

For approximately the last two decades, the United States has been faced with increasing competition. Developed countries flood our markets with high-technology goods, while the developing nations contribute low and medium-technology goods. We are experiencing a technological crisis and must act now to improve our ability to compete successfully with foreign firms.

The cumulative effect of these developments suggests that a major reassessment of policy affecting small business may be appropriate. I would hope this Agency might play a major role in establishing such a policy.

There are a number of areas of responsibility at SBA that are helpful to the small innovative firm. In addition, legislation has been introduced and a number of bills passed which will eliminate some of the problems facing small business.

LEGISLATION

The last Congress was particularly aware of the need to assist small business and passed legislation which removed obstacles that stymied the small firm. For example, Public Law 96-317 was the first patent system reform in many years. Among the reforms were improvements in small businesses' ability to retain title to patents developed with Federal funds. Public Law 96-477, the Small Business Investment Incentives Act, should improve the opportunities for small businesses in the high technology field to raise capital. Public Law 96-354, the Regulatory Flexibility Act; Public Law 96-481, Equal Access to Justice; and Public Law 96-511, the Paperwork Reduction Act, should all help reduce the regulatory burden imposed on small companies by the government. Finally, the President's tax bill should provide an incentive to business to increase their own R&D expenditures. What remains is improving small businesses' access to Federal R&D budgets.

Earlier this year the Small Business Innovation Research Act was introduced. Studies have found that half of all major innovation come from firms with less than 1000 employees. Fifty percent of the Nation's growth stems from technological innovation and small firms have been far more efficient in producing these breakthroughs than large business. Despite almost overwhelming evidence of small businesses' innovative success, small business has received less than 4.1 percent of the Federal Government's research and development budget.

S. 881 which is modeled on the National Science Foundation program, would facilitate small business participation in Federal research and development projects. Those agencies having research and development budgets over $100 million would be required to allocate at least one percent of these resources to a small business innovation research program enabling small business to develop new products that are designated national need by the agency.

Two of the three steps which a small business must follow according to the bill are funded by the Federal Government but industry pays for the commercial application of the research.

Each phase must be judged successfully completed by the small business before an advancement can be made to the next level.

In Phase I small businesses submit proposals to an agency regarding that agency's research and development objectives. Those projects which are selected can receive up to $50,000. If the initial idea becomes marketable, in Phase II the firm can receive from $100,000 to $500,000. Those firms which can attract outside capital are given special emphasis. Phase III is the production and marketing of the technology financed by private capital.

While strongly supporting an expanded Small Business Innovation Research program the Administration objects to the mandatory one percent set-aside in agencies with research and development budgets over $100 million. We feel that the rigid application of a fixed set-aside does not provide sufficient flexibility. Federal research and development differs in important respects from agency to agency. Different agencies have different missions, different technology, different time horizons, and deal with different types of entrepreneurs.

Therefore the Administration has recommended modifying S. 881 to provide a four year expanded SBIR pilot program. We have recommended that the Department of Defense, Department of

Health and Human Services, Department of Energy, and the National Aeronautics and Space Administration and the National Science Foundation participate in the expanded pilot. Together, these agencies account for 90 percent of all Federal reseach and development expenditures.

And instead of a uniform inflexible set-aside in each agency, the resource allocation process be integrated into the goal setting process of P.L. 95-507 which Congress has already created. It is through this procedure that SBA primarily carries out its obligation to make certain that small business receives its fair share of government contracts. By employing this mechanism, an expanded SBIR would be less disruptive to the Federal procurement process. And differences in agency needs could be accommodated. With these changes, the Administration wholeheartedly supports S. 881.

I support the concept of the Small Business Innovation Research Program and feel it is a significant way in which productivity can be increased, and continue to preserve the quality of life we all enjoy.

INNOVATION CENTERS

Through earlier legislation, Congress requested that SBA initiate an experimental project designed to assist inventors and innovators to bring new products and processes to the marketplace. In October 1980, under cooperative agreements, SBA funded three Innovation Centers from FY 1980 appropriations totalling $716,878. Based on unsolicited proposals, agreements were signed with the Center for Innovation in Butte, Montana ($250,000); the Golden Gate Energy Center in Sausalito, California ($243,108); and Commercial Credit Management Corporation, a subsidiary of the Control Data Corporation in Baltimore, Maryland ($223,770). For Fiscal Year 1981 the budget for the Centers is approximately $700,000.

Each of the Centers was to provide, as needed, such services as market research and planning, development of financial accounting systems, planning for production, purchasing, personnel, source analysis for venture capital, engineering and design consultation, and prototype development and testing.

The three organizations differ in several major respects:

1. Golden Gate is focusing on renewable energy products and processes selecting clients almost exclusively in the San Francisco area in conjunction with our district and regional offices, and the regional office of the Department of Energy. We understand it is also working closely with other Federal and state agencies and is trying to develop a manual on how such a center could be replicated in other SBA offices.
2. Commercial Credit is using the nationwide network of Control Data Business (Resource) Centers as the contact point for their services. Commercial Credit is concentrating on high technology products such as

electronics, computers, and uses a fee schedule for its services. It primarily works within the corporate structure of the Control Data Corporation and is actively soliciting leads and referrals for new clients.

3. The Center for Innovation in Butte, Montana, has been operating primarily in SBA Region VIII for several years. Its major experience has involved products relevant to this area, i.e., agriculture, mining, and energy.

The differences between the Centers--fee structure, geographic concentration, type of product, and client solicitation procedure--formed a national experiment which was intended to provide balance in the program design.

Between May 22 and June 12, 1981, an assessment of this experimental program was carried out by two SBA staff members. It included visits to the Centers and interviews with their staff and a sample of clients. Telephone interviews with clients were also conducted.

The assessment can best be described as impressionistic and judgmental rather than scientific and empirical. The reasons for this, revolve around the short period of time of the experiment, and the high risk nature of its goals--bringing technologically new products to the marketplace. The professional literature on new product development reports that a period of four to eight years is required to bring new products to the marketplace. SBA's involvement was for eight months in the lives of a few new products. It is very difficult to forecast the future of a small business which is to develop, market, and make a profit with a new product. These two factors, time and risk, prevented SBA from carrying out a rigorous assessment.

The innovation center concept is an interesting experiment. At this point in time the experiment simply does not reflect, the solid evidence needed to continue the Centers within the present environment of reduced agency resources.

Although the Centers are a fine initiative it would be hoped that the funds would come from the marketplace so that industry would undertake the needed innovations. The financial assistance necessary to nurture new firms to fruition countermands the thrust of the President's economic recovery program.

PROCUREMENT AND TECHNICAL ASSISTANCE

Under Section 9(b) of the Small Business Act, SBA is mandated to conduct a program which would deliver to small business concerns the benefits of research and development performed under government contracts or at government expense. In addition, we are directed to assist small firms in their efforts to obtain government contracts for R&D. The primary effort is directed toward technology transfer - the identification of the best available technology to assist a small firm in solving a problem, improving a process, or developing a new product.

The current method of informing the small business community of this available service is through incremental mailings of the Reader Service Card to small firms in selected Standard Industrial Classifications, drawn from Dun & Bradstreet, which include those firms engaged in high-technology work and R&D. Our regional Technology Assistance Officers (TAOs) are assigned cases based upon the Reader Service Card responses received from small firms. Upon receipt of the completed Reader Service Card, the TAO contacts the small business, explains SBA's technology assistance service and helps the small firm to clearly and adequately define its problem or request.

The next step is to identify and locate the required information by using computerized searches of government and private sector data banks or other resources available to the TAO. This data package is forwarded to the small firm at no cost, and SBA frequently assists in providing additional technical publications related to the specific problem. We have provided this type of assistance to over 2,200 small firms so far this fiscal year.

One of the most significant efforts that we have made in our technology transfer program has been our partnership with selected universities and with the National Aeronautics and Space Administration. We are providing state-of-the art information to the small business at a cost to SBA of less than $100 per case. The results of this program have encouraged us to consider additional sites for expansion because of cost-effectiveness.

We have an interagency agreement with NASA wherein four of the NASA Industrial Application Centers (IACs) are jointly funded to assist our Technical Assistance Officers in Regions I, III, V, VI, and the greater Los Angeles area of Region IX. We utilize their computerized technology data bases, technical experts, and problem solving capabilities to assist small businesses. SBA's FY 81 funding level for these IACs is as follows:

NASA IAC - University of Southern California	$ 35,000
New England Research Application Center University of Connecticut	55,000
Kerr IAC - Southeastern Oklahoma State	22,000
Aerospace Research Application Center Indiana/Purdue University	25,000
Total	$137,000

This joint funding arrangement gives us the greatest possible leverage because we are participating in an on-going program where the basic overhead and indirect costs are not supported by SBA.

In addition to these four Centers, we fund a unique program with the University of Kansas at Lawrence, Kansas which provides technology assistance to small firms in Kansas, Missouri, Iowa, and Nebraska. Under the direction of a senior faculty member, this program employs a small core of engineering and scientifically trained students to identify needs and search the appropriate literature and data bases. Additional faculty and staff are called upon for periodic consultation as specialized technical knowledge is required for more effective problem identification and information retrieval. Last year, this program alone was able to bring technology assistance to over 400 small firms.

To summarize, this cooperative effort with the academic community, NASA and SBA has made available the combined information of over 100 separate government and private sector technology data bases to the small business community. The comments and testimony of these client firms indicate that the savings increased productivity and profits far exceed the cost of this service.

To assist small R&D companies in obtaining government contracts SBA is helpful in a number of ways. They are: (1) identifying procurement opportunities; (2) supplying the buying activities with the capabilities of potential small R&D and high technology contractors; and (3) providing opportunities which will increase the communication between these firms and the Federal agencies that are significantly involved in R&D programs.

With respect to identifying opportunities, Public Law 95-507 for the first time, stated explicitly that R&D procurements were suitable for small business set-asides. We believe that this will prove to be helpful in the ongoing efforts of SBA Procurement Center Representatives (PCRs) to increase the number and dollar value of the set-asides. Our PCRs review Advance Procurement Plans on an ongoing basis for the purpose of breaking out those portions of the procurement that would be suitable for small R&D firms. When such a procurement is identified, the next step is to quickly provide the procuring agency with the profiles of those firms that have the requisite capabilities for performance on the contract. This is now accomplished by our Procurement Automated Source System (PASS) which can provide a 45-second response to these queries.

PASS was established to improve potential government contract and subcontract opportunities for small firms and to be responsive to the requests of government agencies and major corporations for profiles of potential bidders. PASS uses a key word system which identifies and matches the capabilities of the company to the requirements for contract performance. The system can be searched for firms by geographic location, type of ownership, labor surplus area and other data elements. The system is designed to provide small business sources for a specific contract opportunity. Over 10,000 of the 46,000 small firms now registered in PASS have indicated capabilities in the R&D field.

The SBA Procurement Source Specialists located in each SBA Regional office can instantly furnish a computer printout of small businesses registered in the system with the capabilities required to supply the product or the service required. Over 85 remote terminals nationwide have direct access to instantaneously retrieve profiles by searching and matching over 7,000 key words. In addition to SBA Regional offices, these terminals are located at 22 Department of Energy installations, more than 25 other government procurement offices, and at major prime contractor procurement centers. Finally, SBA is involved in a continuing program to sponsor, support and encourage participation in conferences and seminars at the Federal, state and local levels designed to bring together high technology firms with government buyers of research and development. These efforts include involvement with the Department of Energy; National Aeronautics and Space Administration; National Science Foundation; National Bureau of Standards; Department of Defense; Housing and Urban Development; and Health and Human Services.

THE OFFICE OF ADVOCACY

The Office of Advocacy has been actively involved in the innovation area and will continue its efforts to identify the needs of high technology firms and to formulate solutions. For instance, the Office of Economic Research has funded several projects in the last two years which have explored the innovation process and the problems entrepreneurs encounter as they establish small high technology firms. As you know, such small business related research is sorely needed. Among the studies have been analyses of: the role of patents in the commercialization of new technology for small innovative companies; an investigation of the cost, availability, and market efficiency of informal risk capital; and, the relationship between industrial concentration and technological innovation. In addition, the establishment of our small business data base should help us understand the impact of Federal policy on innovation.

In 1979, Advocacy assembled a panel of high technology firm owners, managers and venture capitalists. The task force held several meetings and assembled a report which catalogued much of the work in this area. The report and several recommendations were adopted by the White House Conference on Small Business and were included in new bills introduced in the last two years. The Regulatory Flexibility Act (P.L. 96-354) and parts of the Patent Reform Act (P.L. 96-317), were among those recommendations.

To the extent possible, Advocacy has tried to foster the entrepreneurial spirit; instill the principles of entrepreneurships in young people; and create situations where entrepreneurship can go to work. The Office of Advocacy has been involved in several projects to accomplish this such as development of curricula strategies for grade schools to colleges for the purpose of identifying entrepreneurship as a career opportunity; a pilot venture intern program with the UCLA School of Management; and interactions with several other agencies to ensure consideration of small businesses' role in innovation within their program structure.

Mr. Chairman, this concludes my prepared remarks. I would be pleased to respond to any questions.

Mr. GORE. Thank you. We will finish the panel before going to questions.

In order to clarify the record, in introducing our next witness, let me say that Dr. Luff was assigned the responsibility at SBA of evaluating the small business innovation centers and came to the conclusion after a lengthy evaluation and study that they should definitely be continued.

Mr. Templeman, you are new to SBA, coming in with the new administration, and have implemented its decision to terminate the innovation centers, in spite of Dr. Luff's recommendation, and Dr. Luff has now left the SBA.

And we have invited you here to testify on the study you conducted prior to leaving SBA. So welcome, and please proceed.

STATEMENT OF DR. ANDREW LUFF, MANAGEMENT CONSULTANT

Dr. LUFF. Thank you, Mr. Chairman.

May I take a moment before I get into the testimony to explain how I happened to come to SBA in the first place and some of the background which I brought with me?

I happen to have four degrees in engineering and in physics and those kinds of areas. Unlike Mr. Rabinow, I have nothing near that number of patents, but I do have four. [Laughter.]

Mr. RABINOW. I only have two degrees. [Laughter.]

Mr. GORE. Let me get this straight. Now you have four degrees and four patents. And you have two degrees and 216 patents. [Laughter.]

Dr. LUFF. We are equating apples and oranges.

Mr. GORE. I have no patents. All I have is the gavel. [Laughter.]

Dr. LUFF. I have been interested in the innovation area for the past 25 years, both as chairman of an engineering department and also as a private consultant. I have been responsible for working with many large companies such as Kellogg, General Foods, Eaton, Lear-Siegler, and so forth and many, many small companies, probably something over 100 small companies, in many instances helping the small companies with their startup problems. This was long before there were such things as innovation centers, and the words "venture capitalist" was not popular jargon; it was a matter of finding those resources for a young or upstart type of inventor who was looking for a way to get started, to get patents, to get funding, and so forth.

So I was invited almost 2 years ago to come to Washington to work with the Office of Advocacy. And, specifically, the assignment I had initially was to work with the group of people to which Mr. Templeman referred; those who had put together a comprehensive study, incorporating many of the innovation studies which had been done previously.

In working with them, we came up with several ideas. One of the ideas was that there should be a National Council for Small Business Innovation. It would consist of people located in each of the 10 SBA regions who could be called upon for input in terms of what were the needs of the small businessman, particularly the high-tech innovator type.

Dr. Jerry Plunkett, who happens to be here today, was chairman of that particular committee, and if there are any questions about its activities, I think that he could well answer them.

It was felt that the problem of innovation was extremely serious in the nation. Yesterday we heard statistics quoted, and the question becomes, is there more innovation, less innovation, or approximately the same amount of innovation? I look upon that as really an exercise in numbers. Not an exercise, in fact. The fact of the matter is that we need new jobs in this country. We do need higher levels of productivity.

In my opinion, I feel that one of the easiest and quickest ways to obtain that is simply to create new products, new processes, which result in many new jobs and put many more dollars into the economy.

With this point in mind, it was decided that a show should be mounted, a museum show, if you please, to travel around the country for 2 years in each of the SBA regions to call people's attention to the fact that this is a serious national problem—hopefully to bring forth people with ideas who might then say: "This is something I have been thinking about inventing or this is something I have invented, now where can I get help?" The show was designed around this particular theme.

It was a matter of selecting, innovators whose work would be shown, and there were five criteria established originally. One, obviously they should be American. No. 2, it should be a product which has resulted in patents. It should be a product which everybody should recognize. It should be something that has resulted, as I said earlier, in many, many jobs and millions of dollars being created in wealth. It should be something the guy did by himself, without university support or corporate support, but some person working on his own, as somebody pointed out earlier, tinkering in the basement under a bare-bulb type of activity.

Another criterion which was established was that it should be from this century. And that is where we got into difficulty. It was very easy to find a number of inventions in the 19th century, but in the 20th century it became a very serious problem, particularly when we were limited to American inventors. There are a lot of foreign inventors, a lot of foreign patents. As we all know, this is what the trend has been over the last few years.

So with that point in mind and really with a need for a museum show having some showmanship attached to it, we decided to go back to the beginning. Benjamin Franklin was selected for his invention of the bifocal. He is enshrined in Philadelphia and is referred to as the country's greatest single innovator.

The bifocal, of course, everybody recognizes. Sooner or later all of us are going to be plagued by them. The story behind his invention—whether it is truth or fiction I don't know, but it makes a good story—is that he, as we all know, had a thing about women, and when he was riding in his carriage, he would look out of the window and see beautiful women, and so he would have to put on one pair of glasses to see, and then he would turn back to what he was reading and had to put on another pair of glasses to read the script. And so he decided to cut two pair of glasses in half and literally glued the bottom part of his reading glasses to the top part of the seeing glasses, and that was the invention of the bifocal, which, incidentally, was not improved upon until approximately 1950. This was the basic process that was used in making bifocals. So it made a good story, a good show, and it is something that is part of this exhibit.

In addition to this, we took a number of other inventions with similar types of stories. We took, for example, the zipper, and this was a very interesting invention. A fellow by the name of Judson invented it. And initially he put it on a pair of boots, which at that time were laced up types of things. This made it very easy to put your boots on and off. He wandered all around trying to get somebody to pay money for this innovation and just could not raise any funds. He had the same sort of problems then as you have heard here. And finally he found a fellow by the name of Colonel Walker, who was a veteran of the Civil War, who was able to convince some people to put some money into this innovation. The zipper became a matter of fact.

The interesting point in this particular exhibit is that everybody who sees it is completely flabbergasted. And most ladies say, for example, "Gosh, I never knew a zipper had to be invented. I have always had zippers." [Laughter.]

I think all of us depend very much on them today.

Part of this show is what is termed the world's largest zipper. It is a 7-foot by 3-foot zipper made of plexiglass, and one can run the zipper up and down to see how it really works.

And incidentally, in each of these exhibits, we have the original patent, a photocopy of it, mounted on the back panel. We have an image of the inventor mounted and models of the invention so it is workable so people can play with it.

In this particular case, we have the original pair of boots which were used by courtesy of the Talon Corp., encased in plexiglass, and traveling with the exhibit.

This is the basic format. There were a dozen inventions. I don't want to bore you with all of them, but this was the thing we were looking for.

We did publish a booklet, and unfortunately the picture on the first page is a little out of date, but everything else is as the way it should be.

Mr. Gore. Most unfortunate.

Dr. LUFF. But Jimmy Carter did say something nice about the exhibit.

We have a page devoted to each of the inventions with a script and a little picture of the inventor and so forth.

I understand the show is now in Dallas. It started in conjunction with Small Business Week last May a year ago. It has been traveling for the past year. It is scheduled for this coming year and will close in Philadelphia during Small Business Week, May next year.

All of these inventions were selected with the innovative point in mind. There was a story in Inc. Magazine about the inventions. And this is in my testimony. It sort of states what basically it is all about. And in fact—what we were looking for there, as I say—was simply to make people aware that we need more inventions, and we need to create companies which will grow.

I think that the kind of companies we have mentioned have resulted in thousands of jobs and millions of dollars. The surgical heart valve is another one which is very important. The phonograph, telephone, the zipper—the ice cream cone—we threw that in because a lot of kids go through the exhibit. Most people never realize the ice cream cone had to be invented. The safety razor, xerography, bakelite, light polarizing film, a steam engine lubricator, and, the final one—up-to-date for the younger group is an electronic music synthesizer, the Moog unit, and Bob Moog, by the way, was at our opening and did play his own instrument for the people here in Washington.

This was one of the things that we were doing, and this was part of the work with the Council: Getting this list together, getting the bibligraphies, all of the materials which were needed and working with the companies which today are responsible for these products; such as, American Optical, Talon Corp., RCA, and so forth.

The other project which we worked on, as I mentioned, in addition to the Council on Innovation, was the concept of innovation centers. Back then—this is going back, say, a couple of years—it was a fairly new thing. And, as a matter of fact, Dr. Plunkett is sort of the father of the innovative center idea. Nobody has really challenged me on that, his center goes back about 5 years.

The history of the money that came to SBA is interesting, and I should probably mention that to clear up any confusion. The money was specifically put into the budget at the request of the Senate on the basis that we need to get more people inventing things, bringing these inventions to the marketplace, and particularly looking for replications of the great inventions which I listed. And, of course, there are hundreds more.

At that time, it was felt that Dr. Plunkett and his Center for Innovation in Butte, Mont., was a model which could be followed. The original idea was that we would replicate his center in four or five major cities, specifically where we have tremendous problems with employment. Nationally it is in the Midwest where we have lots of production facilities idle and lots of people idle. The need there is for products that could use that specific manufacturing capability and use a lot of the skills of the unemployed people. The high unemployment in the Northeast where we have a problem with the mills closing down and the other areas of the country where pockets of unemployment prevail are all prime candidates for innovation centers.

The thought was to start with maybe two, three, or four and see if the thing would work. The feeling is that wherever the center is, it has to be working with products and processes indigenous to that region. The same thing will not work in every region of the United States because of the tremendous difference of skills and manufacturing facilities. I think we have observed that already in the period of this experiment.

The experiment was changed somewhat from the original concept, and it was decided to provide partial funding for three centers and see how effective they were. One was the Control Data approach, which was done through Commercial Credit, of which you heard something yesterday from Sherman Ambrahamson.

Another was the Golden Gate Center for Energy Innovation in Sausalito, Calif. There they worked specifically with energy. This center is funded by the Department of Energy and the Department of the Interior. They are using an old Army base for their operation.

And the third was Dr. Plunkett's Center for Innovation in Butte, Mont.

We set out on this evaluation, which was part of my work statement, and spent about 1 month. It really was not a long, involved study. We did visit each of the centers, and we visited most of their clients. Those we could not visit in person, we talked to on the telephone and asked questions as to how effective the center was, what did it do for them, where would they be without the help they got from the centers. Specifically, what was the funding relationship they had with the center? What was their understanding? What was the center's understanding? We wanted to see if, in fact, the people who were being served were served adequately.

I would say without reservation that in all three instances we found more good than we did anything else. We did find some problems with some of the centers. In California, because it was brand new, they really did not have the kinds of evaluative techniques, the kind of paperwork that was necessary. There was not the kind of close supervision that there should have been with SBA.

We found with Control Data that they were more interested in numbers to get started with, and of course some of the projects they were funding were, in our opinion, not highly innovative but nonetheless were terribly important.

At the Center for Innovation in Butte, Mont., we found, because they had been in business for 5 years, they had a fairly decent system. And as a matter of fact, it was interesting; the other centers said that they were using a lot of that center's materials as part of their processing.

Let me just outline three inventions which we found, and then I will stop.

I think the thing, as Don Templeman pointed out—centers are expensive; it is an expensive proposition. But I think in terms of what the cost-result ratios are, we have to look, very seriously, at what we are really doing.

One of the inventions was for a device which fits on the front of trucks, which are used all over town. You see them around here—delivery trucks, furniture trucks, department store trucks, these kinds of vehicles. And this fellow had worked out a device which cuts the wind resistance way down. As a result—and they had much data to support this—it will increase the efficiency by reducing gas consumption at least 15 percent in these vehicles, which is an astronomical figure when you multiply that times the number of small trucks running around the country. This is a cone device which can be mass produced very easily. It is thermodynamically designed—designed in three basic sizes, so it fits practically any one of these kinds of trucks.

And then in addition to this, it has a lot of other things, as most inventions do. It can be used for additional storage in the truck. So you increase the capacity of the truck.

It is similar to the deflectors being used on the top of tractors pulling semis—the same device—but this is for the smaller models, and it is an integral part of the truck.

The inventor is now negotiating with some manufacturers. It will be used currently solely as an accessory but, hopefully, very shortly will come out on Ford trucks as a part of the standard equipment.

The second one was a device which a person had developed which tells a truck driver when his rig is going to roll over, which is pretty important.

Mr. RABINOW. Does it tell him to pray? [Laughter.]

Dr. LUFF. I will tell him to have a tape recording that automatically prays, so he doesn't have to spend his time doing it.

It is a device that will work on impedance or capacitance by a rod through a wire which is fastened to the shock absorber. In addition to this dramatic application—and, of course, truck rollovers are national disasters, particularly when they are gasoline trucks or something of this sort—it also will prevent pilferage. One of these devices was mounted on a truck—and I got on the truck and jumped up and down, and it told me I was jumping up and down.

The truck driver could go into a diner, leave his rig outside—and of course nowadays there are a lot of ripoffs of the trucks in that particular moment—he can have a beeper in his pocket, and the little device would activate the beeper so he would know that somebody had shifted weight on his truck, and this was sensitive down to about 10 pounds.

It also could be used to prevent pilferage on docks and other areas where vehicles are loaded and unloaded. It also balances the weight.

Most importantly, the reason the guy invented it in the first place was that it will tell you when you have loaded the truck correctly, not overloaded it or underloaded but when you are right where you will pass through the various States measuring mechanisms without any difficulty.

The third I would like to mention, the one that John Eastin has spoken about, his invention—I was terribly impressed by the fact that this ammonia nitrate process which he has invented is astronomical and almost mindboggling in the sense that what he has come up with is a Rube Goldberg type of machine device which is self-supporting. It needs practically no maintenance and will produce for the farmer all of the nitrates he needs.

As a byproduct of this, I understand it can be used to convert human excrement, if you will, into active fertilizer, which would be of tremendous value in the underdeveloped nations. John is already working on this. I said: "John, let's get this one finished first," which he is now doing.

Now, John, as he testified a moment ago, was given something like $14,000 when he was on the verge of quitting. His house was sold; his wife was mortgaged and was about to leave him. Everything was going wrong. And suddenly he saw a blurb on television which said, "There is a center here which could maybe help you." He went there; they did. They analyzed his needs, and the most important thing is something that is not monetary.

The most important thing they did was to put John in touch with an entrepreneur. John admits, as an inventor, he is not really good at peddling his merchandise. They put him in touch with a guy who is a professional peddler of farm equipment. And my understanding is, some of the units have already been sold. He has promissory notes for many, many more, and he is on the verge of a several hundred million dollar business which will create many, many jobs and will create millions of dollars in wealth and could be as revolutionary to the farming community as Benjamin Franklin's bifocals were to people's seeing. It is of that kind of magnitude.

Now these are the three sorts of things that came out of this one center.

We've looked at about 17 or 18 different inventions. They were not all quite this novel or with this kind of potential but certainly tremendously important to our national well-being. And this was why I came up with the recommendation that the centers should be continued and be very specific. I sort of tend to agree with Mr. Templeman. I am not sure that SBA is the place they should be; that would be my only qualifier.

I do feel that what is required is a tremendous level of expertise. To be able to identify the projects and work with them takes a tremendous amount of imagination. I think it would also take a good deal of money, perhaps far in excess of what SBA would be budgeted to spend and, third, would require a tremendous support from the top-level management and administration in the department or agency.

One of the idle thoughts I had on this particular thing—and I will stop with this—is that perhaps the Department of Defense would be a natural for this sort of endeavor. One of the other inventions which we ran into was a scope which corrects for parallax. This, as you recognize, is very important to all of our military weaponry. I am not quite sure how this device works, but it is my understanding that it does work. One of the ordnance divisions has ordered 80,000 for evaluation in the Defense Department. This is another project that comes out of one of these innovation centers.

So perhaps with that, I should quit. I would be very happy to answer any questions you might have.

I am not peddling magazines, but in the current issue of "Science Digest" there is a good article entitled "Making Bright Ideas Pay

Off," which is specifically quoting me—but more important it quotes Dr. Plunkett and other people in this field in innovation centers, and what the tremendous payback could well be.

Thank you very much.

[The prepared statement of Mr. Luff follows:]

TESTIMONY PRESENTED TO THE COMMITTEE ON SCIENCE AND TECHNOLOGY SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

by

Andrew C. Luff, Ph.D.
Management Consultant
Kalamazoo, Michigan

Honorable Chairman Gore and Members of This Committee:

The very beginnings of our nation reflect a truly innovative spirit. This innovation has been declared and set forth in our basic documents, i.e., the Constitution, Bill of Rights, etc. The founding fathers were themselves innovators. As a matter of fact, the memory of Benjamin Franklin is enshrined in Philadelphia with the declaration that he was this country's greatest innovator. The entrepreneurial ability which is closely aligned to inventive genius is reflected in the occupations which our founding fathers pursued. From the beginning our nation has emerged as a world leader and power, largely because of the fact that historically we have come forth with some of the fundamental and far-reaching inventions which have changed the entire course of history. That spirit is seriously threatened and it is, in my humble opinion, the purpose of this Hearing to explore ways by which we can rekindle the fire which made America great.

As President Reagan indicated in his message concerning the nation's economy, delivered to the joint Congress, small business is responsible for approximately one-half of all jobs in the United States and for more than one-third of our gross national product. He also stated that the vast majority of new jobs come from the small business sector. In addition, small business is responsible for an estimated one-half of our major innovations.

To those of you who may not be familiar with the work of Dr. Birch of the Massachusetts Institute of Technology, he has found that some 87 percent of all new jobs in the private sector of the nation between 1969 and 1976 came from firms with 500 or less employees, 66 percent came from firms with 20 or less employees. In a similar study in Canada, it was found that 72 percent of all new jobs in the private sector came from firms with 20 or less employees.

In technological innovation, small business has been critically important to this country. One National Science Foundation sponsored study found that small firms with up to 1,000 employees contributed 24 times the number of major innovations per dollar of research and development expenditure as large firms with more than 10,000 employees. Many other studies in the steel, aluminum, petroleum, and food processing industries have found that independent individuals and small business firms are critically important to the innovation process.

* The Jewkes Study on 61 important inventions and innovations in this century showed that over one-half came from small firms and independent inventors.

* The Hamberg Study found that over two-thirds of the major inventions between 1946 and 1955 resulted from the work of independent inventors and small companies.
* Professor Hamberg also studied 13 major innovations in the American steel industry. Four came from European companies, seven from independent inventors, none came from American steel companies.
* The Peck Study of 149 inventions in the aluminum industry found that major producers accounted for only one of seven important inventions.
* The Enos Study considered seven major inventions in the refining and cracking of petroleum. All seven were made by independent inventors.
* And finally, the Meuller Study of the food industry found that firms with sales under $10 million annually accounted for nearly one-half of all major innovations.

Economists generally conclude that small business has accounted for a disproportionate number of the nation's technological innovations. And these innovations have been contributed by small business which conducts less than 4 percent of our nation's research and development.

Many of our small science and technology firms have outstanding research and development capabilities which are of interest to the federal government. Of the top 500 research and development contractors for the Department of Defense, 198 are small business firms. Small firms are important to

NASA and were responsible for much of the early solar energy research. Currently the National Science Foundation and the Department of Defense have programs which not only involve research as one of those agencies' objectives, but also encourage the conversion of that research into commercial applications and technological innovation with private venture capital. Government funds are used solely for government research and development. Private funds support the pursuit of commercial objectives. I feel this is an excellent way to increase the return on investment from federal research and development at almost no additional cost to the taxpayer.

In the Fall of 1979 and Spring of 1980 it was my privilege to put together an exhibition which is currently touring the nation. The exhibit, sponsored by the U.S. Small Business Administration, opened the 1980 National Small Business Week, an annual event which honors the nation's 10 million small businesses. The exhibition contains a dozen important inventions by American small business people that have changed this nation's--and the world's--way of living and working.

Visitors not only are able to see and hear about the products created by American ingenuity, they are also able to hold and operate them to better understand the scientific and technological principles involved and what led the American entrepreneurs to create them.

By touring the nation during the past year and the coming year, the 1,500 square-foot exhibit will encourage a greater understanding and appreciation of the role of small business innovation in America.

As was stated earlier, such innovation creates more than half of all new products and new jobs in this country.

"Eureka! A Celebration of American Small Business Innovations" displays products from more than 200 years of American inventiveness, including:

The bifocal lens, the surgical heart valve, the phonograph, the telephone, the zipper, the ice cream cone, the safety razor, xerography, bakelite, light polarizing film, a steam engine lubricator, and an electronic music synthesizer.

The zipper display features a large-scale model of a zipper with a clear plastic tab that visitors can pull to see how the teeth mesh. Also displayed is the first pair of shoes with a zipper closing, which the inventor, Witcomb L. Judson, used to promote his device invented in 1892. A commonly heard comment expresses surprise that the zipper was an invention--many people assume that it has always existed.

Visitors can pump fluid through the surgical heart valve invented by Dr. Albert Starr and Lowell Edwards. The current state-of-the-art valve--a pig membrane--is shown to illustrate technical advances since the valve's invention in 1961.

How did the ice cream cone come about? A guessing game explains how Ernest K. Hamwi's 1904 idea developed.

Visitors can look through a large bifocal to background graphics that explain how Ben Franklin's 1784 invention works.

They can use a Mini-Moog synthesizer to play various electronic sounds and better understand Robert A. Moog's 1967 development.

A duplicate of the xerographic device Chester F. Carlson first used in 1938 to demonstrate "electro-photography" is displayed.

A working model illustrates simple telecommunications of Alexander Graham Bell's 1875 invention. There is also a display of new fibre optics techniques.

The phonograph exhibit of Thomas A. Edison's 1877 idea permits a visitor to play a 33-1/3 rpm record on a revolving table with a pickup made of a paper cone and a sewing needle.

Graphic presentations tell the stories of development of the steam engine lubricator in 1872 by Elijah McCoy and the safety razor that King C. Gillette started manufacturing in 1901. A variety of bakelite products illustrate how plastic items came into life due to Leo H. Backeland's 1909 pioneering work.

An article in the July 1980 issue of INC. Magazine puts the purpose of this exhibit in a meaningful perspective:

> Like a tin can on a booster rocket, a good idea often starts out small--even laughable. But it can pack a lot of wallop. And once it's accepted, life is never the same. Ask any teenager, for example, if he can imagine Saturday without the phonograph or the telephone.
>
> Moreover, innovations spawn small businesses to nurture and market them, and those ventures spawn yet more innovations to improve our lives.
>
> In May, the Small Business Administration premiered an exhibit of American ingenuity designed to celebrate the bond between innovation and enterprise. "Eureka! A Celebration of American Small Business Innovations" opened in Explorers Hall of the National Geographic Society in Washington, D.C. Over the next two years, the exhibit will travel to New York, Chicago, Denver, Seattle, Berkeley, Dallas, Kansas City, Mo., Orlando, Boston, and Philadelphia.
>
> The exhibit features working models that bring to life 12 of the country's more revolutionary inventions, from Ben Franklin's bifocal glasses to Robert Moog's electronic music synthesizer.
>
> "We're hoping," says Andrew C. Luff, the SBA's entrepreneur in residence and the organizer of the exhibit, "that people who see it will think, 'Hey, I've got a good idea,' and then set out to make it work." With an expected audience of some 3 million people, Eureka! may well succeed in setting hundreds of tin cans in orbit.

During the period of time when this exhibition was being put together, informative discussions were being held with various individuals regarding a concept which at that time was relatively new, but today is becoming more and more commonplace and that is an "innovation center" which is specifically designed to assist in the innovation process which provides the kind of environment in which the innovation process may succeed.

In the Comptroller General's Report to the Congress Consistent Criteria Are Needed to Assess Small-Business Innovation Initiatives of July 1981, innovation is defined as:

> . . . a three-stage process. It begins with the genesis of a technically feasible idea (invention), proceeds with the refinement of the idea (development), and results in the introduction and initial use of new products or processes in the marketplace (commercialization). To this definition, we can add the statement that for the innovation process to be activated, two things must exist. One is the idea--an idea that is the result of individual creativity, which is not subject to policy manipulation. The other is a climate that is receptive to the idea.
>
> Actually, there are three related climates within which any small business operates--the climate in the economy as a whole, the climate in the firm's industry, and the climate in the firm itself. We have termed the confluence of these climates the "environment for innovation." By this we mean the combination of the many complex social, political, economic, industrial, technical, and individual factors that encourage and sustain the creation and development of new ideas. The existence of a receptive environment for innovation is vital for the translation of an idea into practice through the innovation process.

It is the small technology-based firm, possibly more than any other type of organization, that can create technological innovation and the resulting new products, new processes, and new jobs that will strengthen our economy. It is through support of technological innovation that we stimulate the kind of firms that grow. It is through this support that more quality jobs are created. In addition, we improve opportunities for upward mobility of employees, including minorities, and provide for the general growth of small firms. New and growing small firms increase competition and through this process help fight inflation. Many small firms grow very rapidly, far faster than large firms. Technology-based small firms often lead the way. The technology-based firms also have a multiplier effect, not only by creating their own new jobs, but by generating the purchasing power to create many more jobs in stores, restaurants, banks, construction, and in our service industries through their growing payrolls and purchases.

Historically, much of the Small Business Administration's effort has been confined to firms that had been turned down by their local banks and often, by definition, were marginal. I am concerned that possibly too little financial assistance went to small business manufacturers and to technology-based firms. While the 8(a) programs provide an important and necessary service to minority and women-owned firms, in my opinion, too much support is going to too few firms which should have become self-supporting and ceased to need 8(a) support.

In the future, I hope that the Small Business Administration can turn more of its attention to the higher economic leverage of the strong high technology small business firms and to the potential for small business in international markets. I believe that the Small Business Administration can be more effective, possibly with lower SBA expenditures. Much can be done to improve the climate for small business opportunities with federal procurement based upon merit. In addition, new less-costly SBA activities should be encouraged to strengthen the role of small business in the nation.

The SBA should continue to be concerned about the paperwork problem. It should work for the elimination of unnecessary regulations. It should try to improve the information and technology transfer services. It should make sure that small business receives a fair share of federal procurement as the Small Business Act requires. It should continue the loan and 8(a) programs, but with some modifications and should attempt to increase the investments by the Small Business Investment Corporations in manufacturing and technology-based firms. It should be aware of the tax, investment, and patent problems facing small firms.

The agency must continue to provide prospective, new, and established small businesses with financial assistance, management training, and counseling, and must assist them in obtaining a fair share of government contracts. However, I strongly advocate the program, which I am about to describe, as one which should and could become a central thrust for SBA. The unqualified support for such a program could also do much to improve SBA's tarnished image throughout the nation.

As a result of a request by Congress, an experimental project designed to assist inventors and innovators to bring new products and processes to the marketplace was initiated. Under cooperative agreements SBA funded three Innovation

Centers, funding from FY 1980 appropriations totalled $716,878; agreements were signed with: The Center for Innovation in Butte, Montana ($250,000), the Golden Gate Energy Center in Sausalito, California ($243,108), and Commercial Credit Management Corporation, a subsidiary of the Control Data Corporation, in Baltimore, Maryland ($223,770). Each of the organizations was to provide, as needed, such services as market research and planning, development of financial accounting systems, planning for production, purchasing, personnel, source analysis for venture capital, engineering and design consultation and prototype development and testing.

The three organizations differ in several major respects:

1. Golden Gate is focusing on renewable energy products and processes; is selecting clients almost exclusively in the San Francisco area in conjunction with SBA's district and regional offices, and the regional office of the Department of Energy; is working closely with other Federal and state agencies; and is trying to develop a model which can be replicated for other SBA offices.
2. Commercial Credit is using the nationwide network of Control Data Business (Resource) Centers as the contact point for their services; is concentrating on products such as electronic devices and computers;

is using a fee schedule for its services; is primarily working within the corporate structure of the Control Data Corporation; and is actively soliciting leads and referrals for new clients.

3. The Center for Innovation in Butte, Montana has been operating, primarily in Region VIII, for several years. Their major experience has involved products relevant to that area, i.e., agriculture, mining, and energy. They will be expanding their activities, with an eye toward Regions IV and V.

Between May 22 and June 12, an assessment was carried out. It included visits to the Centers, and interviews with their staffs and a sample of their clients. Telephone interviews with clients were also conducted. What follows are edited comments gleaned from that assessment,

The professional literature on new product development reports that a period of four to eight years is required to bring new products to the marketplace. SBA's involvement was for eight months in the lives of a few new products. The inability to predict the success of typical small business start-ups is well known. It is inherently much more difficult to forecast the future of a small business which is to develop, produce, market, and make a profit with a technologically new product. These two factors, time and risk, combine to produce an assessment which is primarily anecdotal rather than systematically rigorous.

The major findings of this assessment include:

1. Each of the three Innovation Centers has provided substantial assistance to their clients. As a result of the SBA-funded interventions, there will be a greater flow of new products and processes to the marketplace. Existing small businesses will survive and expand; new small businesses will start; new inventions will be commercialized; major scientific and technological break-throughs will begin their diffusion through the U.S. economy; increases in productivity and employment can be directly attributed to the actions of the Centers.
2. When users of the Innovation Centers were asked whether this was a "good use of taxpayer money," they uniformly applauded SBA's efforts and felt that while it is legitimate for the Government to help people who need "welfare," the Government really ought to be investing more in the future growth of the economy. Since this project is perceived as trying to fit that need, its reception was enthusiastic. Center clients were not simply saying, "because you are helping me, it is a good program." Their comments seemed to be more objective, "because this is something which will help the economy, be it me or someone else, the program is a wise use of taxpayers' money." In effect, through

this program SBA is being seen as a good steward of the taxpayers' money.

3. Assessing the "quality" of the innovations which are being supported is difficult. Their full economic impact is still too far in the future to adequately measure their contribution to employment and productivity growth, and the health of the small business sector. The range of projects is wide; their potential contributions to cost reduction, energy saving, job creation, industrial development is very great.
4. The imposition of fees for these services is an important and positive component of the delivery system. Any future innovation center program should include a fee structure.
5. The "innovation path" runs between the initial conceptualization of a new idea (the back-of-an-envelope stage) to the appearance of a new product in the marketplace. The process of following the path is rife with difficulty and full of unexpected twists and turns. Risks of failure, both the technical risk and the commercial risk, are very high. Stamina, skill, and luck are necessary, but not sufficient conditions for success. Both the Golden Gate Energy Center and Control Data have selected clients who are "relatively far along" on the innovation path. Their selection of relatively low-risk

clients (low from both a technological and commercial risk standpoint) was a deliberate choice. The Center for Innovation is involved with the riskiest projects of the three Centers.

6. Clearly articulated rules of accountability between all parties, viz., SBA, the Center, and the client, are important to establish. The responsibilities and measures of performance of all parties, while always open to discussion and revision, must be agreed upon. Second-guessing, while tempting, should be discouraged.
7. The development of personal respect and trust between the client and the Center's staff is the most critical factor in determining the success of the intervention. This must be supported by an accurate record-keeping system for monitoring the contacts between the client and the Center. The record-keeping system will, over time, allow for careful evaluation and adjustment of the Center's activities.

The major recommendations of this report and with which as one of its authors I wholeheartedly agree are:

A. The Innovation Center "Experiment" be continued with currently available funds, at approximately the same level. One million dollars of 1981 funds are currently budgeted for this project.

B. The agreement with Control Data be renewed at about the same funding level. Changes in the fee structure, viz., reducing SBA's subsidy rate, will allow a larger number of clients to be served. Mechanisms to induce Control Data to accept some "high-risk" clients should be explored.

C. That the Golden Gate Energy Center's funding be continued. Their criteria for the procedures for searching out clients and the selection criteria must be sharpened. Their current clientele is too "low-risk" to truly satisfy the purposes of this program. The concentration on renewable energy technologies and energy-conservation technologies is worthwhile and should be pursued.

D. The Center for Innovation's efforts to expand their activities in both Iowa and New Mexico should be supported. They also should be encouraged to market their services in the Midwest. States like Michigan, Wisconsin, Minnesota, Indiana, Ohio, Illinois are prime targets for an Innovation Center. Much work needs to be done in helping to stimulate economic growth and jobs in these areas.

E. If any additional funds are available to support the Innovation Center Project, they should be given to the Center for Innovation. The rationale behind this is primarily that they have four years of experience servicing inventors and innovators, and that experience should be utilized.

In conclusion, the encouragement of innovation and support for the innovative process at every stage should be of primary concern to both the Executive and Legislative branches of Government. This is, in my opinion, one of the few ways whereby many of the nation's economic ills may be corrected. It is a well established fact that new products and new processes coming to the marketplace create new jobs and new wealth. As Americans we must, once again, nurture our inventive genius which has, more than anything else, been responsible for the greatness of our country.

Attached to this testimony are copies of letters which are self-explanatory and should be made a part of the record of this Hearing.

COMMERCIAL CREDIT MANAGEMENT CORPORATION

300 St. Paul Place
Baltimore, Maryland 21202
301 332-3000

July 16, 1981

Mr. Andrew C. Luff
549 4th Street, S. E.
Washington, D. C. 20003

Dear Andy:

Thank you for taking time to visit with us and our T/I clients.

You may be interested in the summary of the program and recommendations I have made to our management. I would appreciate your comments.

It seems to me this program could be substantially expanded to the benefit of technology development, employment, small business and the entrepreneurial spirit of our country.

I am not certain of the most effective agency to provide federal support, whether it be SBA or perhaps NSF or DOD; but I am convinced that three elements are essential:

- A broad base of submissions
- Private enterprise involvement in such a way as to reduce gradually federal support
- Federal support to encourage the involvement of private enterprises

Even though they know federal funding is committed for this period, entrepreneurs continue to apply to our company with a request to be put on the waiting list for future assistance if the program is renewed. There are a lot of good ideas out there, Andy; we must find a way to bring them to market under the free enterprise system.

I look forward to hearing from you.

Sincerely,

Robert O. Bonnell, Jr.
Technology/Innovation
Program Director

ROB:mfr

a service of
CONTROL DATA CORPORATION

July 16, 1981

Memo to File

RE: T/I Program - Review and Recommendations

Summary

Control Data/Commercial Credit should seek renewal of a grant from the Small Business Administration to help fund the growth of new and small enterprises through the development of innovations and new technologies that would improve productivity and provide employment opportunities.

Background

A broad base of successful small businesses provides a societal safety factor essential to our country's economic health. It encourages individuals to seek solutions to problems that affect them personally and to pursue opportunities through which they personally will benefit and through which they feel society will benefit. This intimate involvement provides motivation superior to that normally produced by an association with big business.

In addition, dependance on a relatively small number of giant corporations is economically dangerous over an extended period of time. Historically, large and successful business entities lack the flexibility and creativity needed to meet changing natural, economic and technological conditions.

The development of communications is an example. Communications was once less significant than it is today because small communities were economically self-sufficient. Population growth generally, and urban growth specifically, have virtually obliterated community self-sufficiency. As dependence on more remote resources grew, the need for communications through which these resources could be located was created. It was an individual entrepreneur who met this need through the invention of the telephone. Another individual inventor added the telegraph.

Transportation developments followed as transportation became the overwhelming need if benefits of remote resources were to be enjoyed. Here again, an individual proprietor, a bicycle repairman, triggered the solution to that need, and a single lady, who invested $5,000 in Henry Ford's fledging enterprise, enjoyed $12,500,000 in dividends alone in her lifetime. The need became increasingly evident for transportation facilities with greater volume capacity, a cheaper means of locomotion, and higher speed. These needs were met by James Watt's steam engine, the railroad, and the Wright brother's flying machine.

In our own company Mr. Norris recognized the need and a way to streamline information processing, adding to existing capability in an extraordinary fashion. He could not pursue this dramatic change in technology through an existing, sophisticated corporate entity even though it had extensive research capability. He started a small business based on a new idea. The result: over 55,000 people employed in more than 35 countries.

In addition to the importance of individual initiative, the commission of selected individuals to pursue solutions to selected needs is not sufficient. Society's needs are too numerous. For example, the expanded use of renewable resources must be accompanied by improved production of renewable resources. More effective information processing must be coupled with the development of a more constructive societal attitude toward the information processed. Improved medical and nutritional knowledge demands a more effective system for the distribution of food and medical supplies. The breath-taking acceleration of beneficial knowledge requires a more effective means of educating the ignorant, who may be a primitive people or highly intelligent individuals in one field who have not been educated in another.

The pursuit of this broad spectrum of new ways of doing things requires an even broader base of inventive effort. A maximum number of creative individuals must be encouraged to feed society's cornucopia of new ideas so that enough workable ideas will evolve to meet society's needs.

Public-private cooperation is required to meet these criteria. The management expertise of private enterprise is essential to improve the chance of survival for innovative businesses. Some federal funding is needed to help fledgling entrepreneurs afford the consulting and guidance required to supplement their technical knowledge. On the other hand, the entrepreneur must make a financial investment in the workability of his idea to provide the motivation for the long hours and tedium of trial and failure inevitable to success. The Technology and Innovation Program meets all of these requirements. Here are examples of the value of the present government sponsored T/I Program implemented by CCSC. These are only four examples that have surfaced in the past nine months. There are many others.

Case #1

A woman with a close working knowledge of nursing home records administration recognized a need to save the lives of nursing home residents through more accurate monitoring of medical treatment. The need grew out of legislation designed to benefit residents of nursing homes by compelling the nursing home to rewrite prescriptions monthly.

Rewriting meant re-copying. Re-copying handwritten records led to mis-copying and dangerous repetition. Example: A prescription that read, "Continue for three months" could be copied for six months, leading to a nine-month application. If the prescription were a habit-forming drug, the result could be disastrous.

The entrepreneur had a program developed that prevented this problem, providing accurate records and facilitating administrative monitoring.

She knew this innovation was needed but was confused as to how to bring it to market effectively. Through T/I she obtained marketing advice she could afford, increase her orders by a factor of six, and has a business plan for long term growth.

Case #2

A minority inventor, who refers to himself as a "tinkerer", began to rewire his office in Florida to save electricity. He found a way to turn off his lights progressively as the daylight or sunlight became brighter and noticed a distinct reduction in his lighting bill.

In the midst of the government's appeal for energy conservation, he offered this wiring device to one part of a government facility. It was installed, the test was successful, and he began to attract attention for his innovation. He lacked funds for development and testing and had abandoned the idea until the T/I Program was drawn to his attention by a CDC employee.

He now has a business plan, encouragement by the U.S. Department of Energy, interest on the part of a major corporation to use the device in a major installation, and the attention of three potential investors.

Case #3

An inventor developed a series of consumer items that can be produced more economically than present devices serving similar purposes with additional safety features. He had teamed with a well-run workshop for the handicapped to produce the products, but his marketing thrust was haphazard, lacked continuity, and did not produce orders to support production.

An effective marketing effort would produce meaningful employment for a large number of handicapped workers, many of whom have been laid-off due to reduced government programs.

Through T/I Program, a skilled marketing person has been assigned to help develop a marketing plan with the entrepreneur. The potential for increased employment and productivity in this case is very substantial.

Case #4

An employee of a major corporation (Control Data Corporation) worked in the company on a computer program designed to conserve the use of fossil fuels for major utilities. The corporation decided not to pursue the completion of the project, but the employee felt it had significant value.

With the corporation's encouragement the employee entered business for himself, was authorized to use the work already done with the corporation, augmented the system with innovations of his own which he felt he could sell to major utilities.

He requested the development of a business plan through the T/I program as well as assistance in locating resources to help implement the plan. Through the T/I Program, the Business Plan has been prepared in such a form that it can be used to attract venture capital, contact was made for the entrepreneur with a major utility, and the individual is confident that a sale is in the offing for his first system.

Funding

Increasing encouragement should be given (1) to clients to pay for services delivered and (2) to our company to deliver services affordable to the client.

It is recommended that the processing fee remain $150 but that the client pay 20% of the cost of services delivered instead of the present 10%. The increased participation is based upon the apparent ability of clients to pay and on the belief that our improved expertise will increase the value of our services. The additional participation will also act as a more stringent screening mechanism.

An additional flexibility should also be introduced. While the $10,000 maximum government participation should be a part of the program, the client should have the option of spending more money for one phase of service than the present schedule suggests. It is recommended that the present schedule of costs for services be retained but that an additional option for a more complete service should be available to the client.

Example: A preliminary market evaluation might indicate the advisability of an indepth marketing survey; or a $5,000 Business Plan might not be adequate for a particular client. We found this in the case of Electrotec, where services rendered in the development of a Business Plan exceeded the scheduled cost.

Progress

It is very important to recognize the progress made in nine months under this program because this progress indicates the potential for the program. We began with only an idea, to bring new technologies and innovations to the marketplace in the form of new or expanded businesses. There were no guidelines.

With SBA, we conceived, designed, implemented, revised, and administered an effort that produced over 200 applicants, over 60 contracts, and over $270,000 revenue for our company. Our personnel in the B/C's, BAI, and throughout the company began to develop new skills and new markets for non-cash services.

Business and employment opportunities were identified for minorities, women, the handicapped, and majority groups. A few clients already indicate real success possibilities. In addition, we have launched a truely unified corporate program involving many elements of the company in a team effort in addressing two of society's major unmet needs: Technology development and employment through small business enterprises.

A public-private partnership has been mustered and strengthened with an increased private share of the responsibility clearly possible.

While we have not launched a new Control Data Corporation yet, we have helped a few entrepreneurs see more clearly the requirements for success.

If this program is renewed by the SBA, we should capitalize on our nine months' experience through participation in the renewed program. In the second year lessons learned will be even more valuable, and constructive results should begin to become visible through new business developments.

A broadened base of customers for non-cash services and better trained employees as business consultants will result in an increased flow of revenue both independently and in conjunction with government support.

It is recommended that we make every effort to renew our participation in this program without a major change in organization for implementation.

R. O. Bonnell, Jr.

ROB:deb

CONTROL DATA
BUSINESS ADVISORS, INC.

3400 West 66th Street
Minneapolis, Minnesota 55435

July 17, 1981

Mr. Edward Starr
Room 500
U. S. Small Business Administration
1441 L Street
Washington, D. C. 20416

Dear Mr. Starr:

We have received a copy of you and Mr. Luff's assessment of the Innovation Center experiment and wish to commend you for your fair and objective evaluation of our individual efforts.

We are pleased that you have recommended continuation of the project; and agree that it is an effective way to nurture a significant asset of the United States - the creativity and entrepeneurial spirit of our people. It is quite innovative, if you will, of SBA management to recognize the need to explore new ways to enhance the return on the guaranteed-loan investments. For it is obvious that financing is only one of the resources needed to develop a technology or idea, and often both capital and the idea are lost because of the lack of one of the other elements, such as managerial skills or some specific know-how.

Past programs to supplement goverment financial support have concentrated on the use of academic resources, and to good effect. Certainly the Agricultural Extension Service and the Small Business Development Centers have made many significant contributions. But the vast majority of business resourcefulness and know how in this country lies in the domain of private enterprize. This segment, at least in the USA, can bring truly enormous power to bear, should it become so motivated.

The key innovation that SBA brought forth with the Innovation Center project is the effort to involve this power. The Federal bureaucracy is often criticized (by me, among others) for being impossibly uncreative because of its sheer ponderousness. This program demonstrates that some of the experimental spirit survives in that environment, and that to me is noteworthy.

The leadership of the new administration is certainly even more aware than their predecessors of the capital-formation power of innovation and the predominance of the private sector as a source of business resourcefulness. One could hardly find a program which would seem to be more philisophically aligned

CD a service of
CONTROL DATA CORPORATION

with the Reagan administration goals. It encourages technology and innovation, a proven well-spring of America's strength; it leverages the government's investment with committed private sector partners; and it encourages initiative and productivity in the Federal bureaucracy.

Control Data is committed to discerning profit opportunities amid the problems faced by today's society and recognizes the enormous and vital value of creativity and innovation. On its behalf let me congratulate the SBA management for this flare of initiative. We appreciated our participation in this experiment and look forward to the opportunity to work with you in the future.

We also recognize the new administration's quite proper concern for fiscal responsibility and trust that in their zeal for austerity they will not inadvertently or otherwise cast aside a tiny investment which appears to be directly aligned with their major proclaimed values.

Very truly yours,

Donald B. Bonstrom

Donald B. Bonstrom
Vice President
Control Data Business Advisors, Inc.

cc: Andrew C. Luff

Mr. GORE. Thank you.

Mr. Zicarelli?

STATEMENT OF ROBERT ZICARELLI, CHAIRMAN, NORTHWEST GROWTH FUND, INC.

Mr. ZICARELLI. It is a pleasure for me to be here this morning. SBIC's are investment companies, licensed by SBA. It is important to stress that they start with private capital and make their own investment decisions. SBA provides the source of leverage of up to four times the paid-in capital of an SBIC, up to a maximum of $35 million. That money is loaned to them at rates reflecting the Government's own cost of money. To obtain such funds, SBIC's must comply with certain regulations on how they conduct themselves and are restricted to certain types of investments and areas of activity.

The investment policy of most SBIC's is to invest in small business for a modest current return, plus a chance at a signficant capital gain. Most companies we invest in could not receive financing from other sources. We like to direct much of our effort toward technology, because if we win with a technology company, the gains are much bigger.

To a stockholder of an SBIC, success means a substantial gain on his original investment. Northwest Growth Fund, for example, has a compounded growth rate in the last 5 years of over 50 percent. To the Government, a measure of our success would be the benefits

SBIC's provide the economy in such areas as jobs, R. & D., and taxes paid.

Our trade association did a survey, released in February of 1980, to see how we fared in this department. Walter Stoltz, our president, is here, and can make copies of that study available. The study found that companies financed by SBIC's generated 10 times the employment growth of all other small companies. Not only that, but these companies produced jobs for $6,463 as contrasted to estimates that Government spends at least $25,000 to create a job. Growth rate of Federal tax payments of companies financed by SBIC's is over five times that of other small companies. Our company participated in that survey and updated the information to December 31, 1980. A copy of the results is attached as an appendix to my testimony.

The study of Northwest Growth Fund portfolio showed that on investments of slightly over $20 million in 41 companies, held an average of about 6 years, the revenues of these companies increased 376 percent. Exports were up 3,666 percent. Gross payrolls were up over 300 percent. Federal taxes paid were up 665 percent. State and local taxes were up 725 percent. And full-time employment in these companies was up 300 percent; 10,000 jobs were created on an average investment of about $2,200 per job.

Needless to say, we believe that these figures demonstrate considerable success in achieving economic goals of our country. Northwest Growth Fund has made 135 investments in its 20-year history; 58 of them I would categorize as technology-type investments. There is an exhibit attached to my testimony which shows that of these 58 companies, 20 were winners, 16 were losers, and in 22 situations it is too soon to tell.

Our analysis of the 16 losses might be of some interest. We believe that three losses were primarily because of poor or ineffective management. Five losses were because the technology just could not be made to work—misjudgment on our part, as well as that of the people we were backing. Seven failed, because the technology was not economic, or the market was not ready. One died because of a change in Government policy.

Obviously, when you lose, you can only lose 100 percent of your investment. Winners can be much more rewarding. Among our winners, such investments as Cray Research, Network Systems, and Detector Electronics have returned over 10 times our original investment.

Detector Electronics, for example, is a company that we helped three individuals buy out of Minneapolis Honeywell 7 years ago. We invested $125,000 to help the purchase of those assets from Honeywell. Of the $125,000, the company has repaid $120,000. With the other $5,000, we bought 471,000 shares of the company stock, which today has a market value of approximately $8 million.

I think you can see the incentive that we have for making high technology investments. Incentives are necessary for venture capital to be a part of the growth of technology. The stimuli of the capital gains tax reduction, for example, has been fantastic. It has provided a flow of funds into venture capital at an unprecedented rate, and spurred company formations in just about the same level of activity. We are seeing more deals today than at any time in our recent history. And talking to other venture capitalists, I find them just as busy as we are looking at new deals.

There is much interesting technology abroad today, and I would particularly focus, on the fact that the microprocessor is generating an unbelievable number of entrepreneurial ideas. We see people bringing things to us, applying microprocessors to them in such numbers that it is hard to believe and keep up with.

The inventive mind has certainly been spurred by the development of cheap microprocessors. If nurtured, we should have a tremendous period of growth ahead, and venture capital, and small business investment companies, industries, stand ready to serve.

Thank you.

Mr. GORE. Thank you very much. You are a very interesting panel.

Mr. Templeman, you support the small business innovation research program, but you have opposed the 1-percent set-aside. Since you agree that small firms are more innovative, and since studies have shown small firms contribute some 24 times as many innovations per R. & D. dollar spent compared to large firms, why do you believe that a 1-percent set-aside would cause problems?

Mr. TEMPLEMAN. Mr. Chairman, the basic position of the administration on that is that through efforts within four or five of the leading agencies that do R. & D. to promote the small business innovation concept, there is not a need for a 1 percent goal. It is not a view, necessarily, I believe, that it will cause problems; it is a general resistance to goals on particular classes of procurement.

Mr. GORE. All right.

Mr. MASON. I don't understand what he said.

Mr. GORE. Could you explain it more clearly to Mr. Mason.

Mr. TEMPLEMAN. They don't want to be told what to do. That puts it very clearly. They do not want to be told that a particular part of their research and development budgets have to be set aside for small businesses.

Mr. MASON. Why not?

Dr. EASTIN. It doesn't sustain the bureaucracy. [Laughter.]

Mr. TEMPLEMAN. I am expressing to you an administrative position.

Mr. GORE. Mr. Eastin, you are so cynical about this.

Dr. EASTIN. There's nothing cynical about it. It is a fact.

Mr. MASON. That is not cynicism. That's the reality.

Mr. GORE. Let the record reflect the appropriate amount of sarcasm in the phrasing of that. That may not show up in black and white.

Mr. Mason, go ahead.

Mr. MASON. I said it was reality. It's true. Is it more complicated to deal with small amounts?

Mr. TEMPLEMAN. Generally, the perception in the procurement agencies is that it is far more difficult to deal with small business companies, especially in high technology areas. SBA does not agree with that.

Again, I should say that my answer to your question is an administration position. The SBA does not necessarily—I would like to make a personal comment. I drafted the original version of S. 881 in the last Congress when I was in Senator Kennedy's office.

So I am not taking a position contrary to my administration. But you can see that I do not necessarily have a ready answer for you.

Mr. **Gore**. Let's try to pin this down, then. [Laughter.]

Mr. **Gore**. What is the official position of SBA?

Mr. **Templeman**. The official position, as part of the administration, is that this, the small business innovation center concept—or, not "center," but small business innovation program concept—is very valuable. It can be accomplished through a bill that the administration probably will propose that is slightly different than S. 881 and H.R. 3094, I believe, that would call for a 4-year program, run with the major agencies in research and development.

It would call for the same three-phase type program. It would call for a designated amount, an administratively designated amount of support, rather than a legislated 1 percent. There would be a committee cochaired by SBA and someone else designated by the President, some other agency, to oversee the function of this pilot program to simplify the solicitations to get them down toward what NSF has, a 20-page phase I proposal.

The basic support is there. There is a resistance to the 1-percent goal.

Mr. **Gore**. So the SBA's official position is in opposition to the 1-percent set-aside?

Mr. **Templeman**. Yes, sir.

Mr. **Gore**. But the record should reflect that that does not truly represent SBA's view of the idea. It is just that SBA has been coerced by other elements in the Government to adopt that position.

Mr. **Templeman**. I expressed to you a personal thing, not as an employee of SBA; based on the fact that I had the background with that bill when I was not an employee of SBA.

The position of SBA is that this can be accomplished through the administration approach without the 1-percent goal, or 1-percent set-aside.

Mr. **Rabinow**. Mr. Gore, can I make a statement about this small business R. & D.?

Mr. **Gore**. Sure.

Mr. **Rabinow**. OMB, about 4 years ago, set up a panel—I was chairman—to study why it is that when Government contracts let by the Department of Defense, NASA, and all the others, that so little goes to small business. It is not 1 percent. Quite a bit goes, but it is not as much as one would guess from the relative competence per dollar.

The committee consisted of people from the Department of Defense, Energy, State, and all the others.

Mr. **Templeman**. And SBA, because I was on it.

Mr. **Rabinow**. This was an OMB committee. Frankly, I was much surprised, by the results. I tried not to push my personal views, which are quite strong in this respect. I was chairman, and I wanted to see what they would do without my prodding.

And it was unanimously agreed that the amount of R. & D. work that the Government gives to small companies is less than it should be. The reasons for this are several. One of them, of course, is that Government competence in engineering and technology is going downhill. It is going downhill because we, as in the Bureau of Standards, get more money, but smaller staff.

Only in the Government is this ever done: You get more money for doing a project and at the same time your staff is cut by a different part of the Government. In industry, this never happens. If you get more money, you can hire a bigger staff.

The result is that you must give more and more work out on contract, and eventually almost all of the Government officials, technical officials, become desk jockeys. They sit at desks and they hand out money, and they hire people to read the proposals, and they have other people evaluate the work and finally the work reaches the critical mass, which is about 50 percent.

In other words, when the agency has more than 50 percent on contract, what is left to do is essentially to manage the contracts and to do no technical work. And you lose your competence in modern technology in about 5 years. I was once a very good radio engineer. I am not a good radio engineer now, because modern technology, unless you work at it, slips by you very quickly.

The half-life of an engineer now in electronics is about 3 to 5 years. That is, if you work with engineers like Cray, as I did, and you stop working as an engineer, you lose the technical knowledge very quickly. This being the case, the Government techology is going downhill, and the net result is that more and more work goes out on contract.

And if you are incompetent, the easiest thing to do is to give it to give it to a large corporation. You do not have to make decisions of coordinating five small companies, even if they are good. Each of them may be too small to do the whole thing. You give each company part of the job, and then another part to another company, and so on. If you are incompetent—it is much safer to give it to IBM, for example, which is a good, big company, or Control Data, or GE, and wash your hands of it. They will do the whole thing. They will write a good proposal. They will cover you if there is some trouble in the contract, because they know how to do that, too. They have congressional connections, which are sometimes necessary.

And the net result of that is if the final product doesn't work, you can say, "I gave it to the best company in the field. What do you want from me?" If you give it to five little guys and it doesn't work, you are to blame for picking them. The net result of all of this is that it is much safer for an incompetent Government official to give the contract to a large company. This was unanimously agreed by the committee, that the Government has to have enough in-house competence—and I can give you reports on this: How much is enough to properly supervise contract R. & D. Unless the Government does maintain the competence, and unless pressure is put on the Government people to do some work in-house and give contracts to small companies, they will not do it.

It is a fact of life that fixed percentages are no good. I agree, by the way, that you cannot do this—if you are giving out contracts for a trip to the Moon, you cannot give it to small companies. Inherently, it has to be a big contract. On the other hand, in other work you may give it to a couple of little guys. The OMB committee felt unanimously that fixed percentages are not good.

I think 1 percent is too little, anyway, and it really does not mean much. But other fixed percentages are not suitable. The contracting official should be free, but the percentage, whatever it is now, is much too small.

Mr. GORE. Is there any possibility of culling out those agencies or programs where the idea would be inappropriate, and utilizing a larger percentage set aside for the remaining programs and agencies where it might be appropriate?

Mr. RABINOW. Yes, sir. As a matter of fact, it should be done by administrative order. I see no reason why the administration cannot simply say to the various agencies that they should raise the percentage from last year, for example, double it during the next 3 years. This has been proposed—or raise it by something like 5 percent per year. If you gave 10 percent before, then make it 15 or 20, and so on.

This could be done. But the administration has to feel that this is a good thing to do, that small business should be supported. And it has to tell this to the next layer down and the next layer, and God knows the Government has too many layers now. And the pressures will increase.

I think that proper pressures can be effective. I do not think legislation is the way to do this, because you cannot use the same rule for the Department of Defense that you can for the Bureau of Standards.

Mr. GORE. It would never be done in the administration.

Mr. RABINOW. I think it can be done.

Mr. GORE. I agree it can be, but it won't be, just as a practical matter.

Mr. RABINOW. If it can't be done that way, I don't think there is any other way of doing it. I don't think that you can legislate what percentage of Moon shots should be given to small business or to big business. I think that puts you in a straightjacket that would lead to other troubles that are bigger than the trouble you are trying to fix.

I think the administration can do it. I see no reason why the Small Business Administration should not push for this. I think there is enough small business constituency that can write to their Congressman and argue for this kind of thing. I doubt that you can pass a law that says I should give so much, so many dollars, to one kind of company. At least the committee felt it could not be done.

Mr. GORE. Mr. Zicarelli, would your record of investment in 58 technology companies over the past 20 years be fairly typical of the other 300 SBIC's?

Mr. ZICARELLI. I suspect, Mr. Chairman, that we have probably been more aggressive than most SBIC's in venturing with high technology companies at an earlier stage.

Mr. GORE. What percentage of your investments are in startups?

Mr. ZICARELLI. Approximately 25 percent of our investments are startup, or what I would call the first stage financing, where a company has been formed, its product has been developed, and no sales have been made.

Mr. GORE. You state that the SBIC program is an SBA response to a congressional initiative to fill the so-called equity gap. Because of the SBA borrowing obligations, doesn't that limit the types of financing an SBIC can enter into?

Mr. Zicarelli. The restrictions on SBIC's are not significant. They relate to our inability to finance companies who in turn use our money to finance other companies, or to invest in agricultural-type programs which they feel the Department of Agriculture can cover. But beyond that, there are not many restrictions on our ability to do business.

Mr. Gore. Doesn't it bias the financing toward the debt side of the debt-equity ratio? Doesn't it lead to more debt financing, rather than equity investments?

Mr. Zicarelli. I think because of the leverage that we get from SBA, we need to have income ourselves, in order to service the debt; yes.

I do not think that that is a hindrance to supplying capital to small businesses. If the capital gains we make are big enough, the rewards are bigger than the cost of money.

Mr. Gore. That leads to the obvious question of whether that bias toward the debt side means that SBIC's really cannot fill the so-called equity gap.

Mr. Zicarelli. I am sure that we cannot fill the whole thing. I think there certainly is a place which we have found that we can service businesses who could not get money elsewhere. I think that our record of supporting them is very significant.

Mr. Gore. Do you think that the innovation centers provide needed assistance at the early stages, so that they can qualify for follow-on venture capital?

Mr. Zicarelli. Mr. Chairman, I have never been exposed to a company that initially had gotten its support from an innovation center. So I have no way of commenting on that.

Mr. Gore. Dr. Luff, in his written statement Mr. Templeman stated your assessment of the three SBA innovation centers was impressionistic and judgmental, rather than scientific and empirical. I am sure you might want to respond to that. I'm not trying to start a fight here. [Laughter.]

Mr. Gore. Not really. I just want your response.

Dr. Luff. I think there is a semantic implication there which may be unfortunate. I feel that judgmental, yes, we did make a judgment and our judgment was that the innovation center should be continued and our evaluation certainly was of short duration. And this, I think, was necessarily so because the support for the innovation centers from SBA was very short term. And to be able to put any hard numbers together was just literally impossible, if that is what Mr. Templeman means by hard evaluation.

What we did find out was that the support was significant, and what we did find out was that without exception, the people who were the clients of the innovation centers felt that this was a terribly important step toward their success. It may be too early to measure success. I think what we saw with Dr. Eastin, for example, was his machine. We talked with the entrepreneur who was backing him and when we learned of the sales potential, and I felt in view of this that it was something that should really be carried on and it is a very valuable project. But I do not know what the words mean.

Mr. GORE. You believe your background does qualify you to make an assessment of these centers; is that correct?

Dr. LUFF. No question about it.

Mr. GORE. You think the three centers have had sufficient time to develop. Do you consider them cost effective?

Dr. LUFF. Yes. I would say with reservations. I think that the Center for Innovation at Butte, Mont., certainly would qualify on that basis, because they have been doing this sort of thing for at least 5 years. What we saw there was very adequate recordkeeping, very adequate system for appraisal and for evaluation.

The Control Data, my only reservations there is that although they are relatively new in this particular aspect, they do have a management assistant center system developed which they are using as a backup. Certainly there the competence of the people they are using as consultants to the small business community cannot be negated, because they are using very highly qualified experts. The reservation, as I mentioned earlier, at the Golden Gate operation was that it was brand new. It was set up specifically in response to the SBA money, and really did not have the background that it should have had.

Mr. GORE. Thank you. I would like to recognize counsel for the minority, Mr. Clement.

Mr. CLEMENT. Mr. Templeman, as you probably are aware, Congressman Silvio Conte has had quite an interest in both small business and small business administration. He has asked you to respond to the following. In addition to the small business development centers, a valuable program that began as an experiment, the Small Business Administration has been aiding small businesses and small business innovation through the innovation centers program. Hence, for the second year this experimental program which assists inventors in bringing their new products to the market are available. But Congressman Conte has been informed that those funds may not be utilized.

Has a decision been reached as to whether to continue the innovation center's program for a second year?

Mr. TEMPLEMAN. The decision has been reached not to continue the program for a second year.

Mr. CLEMENT. In that case, what was the basis for the decision to discontinue this experiment in assisting small business innovators?

Mr. TEMPLEMAN. The basis for it is while it is obviously a good program and it does good things, in terms of the SBA's role and its mission under the Small Business Act and the administration's desire to eliminate the growth of Government, to reduce expenditures and to use money more wisely, that there are other ways to use those funds which are within the law that established those funds. Probably what it was originally intended for, that will provide a much greater amount of assistance to a much larger number of small business firms.

Mr. CLEMENT. What will the funds earmarked for the program now be used for? Will funds be used to assist small business innovators?

Mr. TEMPLEMAN. They will be used in part to assist small business, high technology firms and manufacturing firms in applying technology that has been developed by the Government in other places.

Mr. CLEMENT. It was used in part for that. What else will they be used for?

Mr. TEMPLEMAN. I am not sure. We have not decided exactly which dollars will go in which place.

Mr. CLEMENT. When will that decision be made?

Mr. TEMPLEMAN. It will have to be made very soon because the fiscal year runs out very soon, but I do not know exactly when it will be.

Mr. CLEMENT. As soon as that decision is made will you provide that information to Representative Conte, please?

Mr. TEMPLEMAN. Yes, sir.

Mr. GORE. Thank you. I'd like to turn now to our panel. Mr. Rabinow?

Mr. RABINOW. I would like to ask Mr. Zicarelli, how do you decide, first of all, how many people should be considered for loans; and what percentage do you support, and how do you decide whom to support?

Mr. ZICARELLI. Probably less than 5 percent of the people who apply to us receive financing from us.

Mr. RABINOW. How do they get to you? Word of mouth? Advertising?

Mr. ZICARELLI. There are a whole host of ways they come in. We have been in business 20 years. That is obviously one reason we get a lot of referrals. Banks refer people to us. The SBA refers people to us. Investment bankers, lawyers, accountants, other SBIC's.

Mr. RABINOW. How do you evaluate them after they get to you?

Mr. ZICARELLI. Obviously we are looking at whether the idea is unique. Can it serve an economic role that is attractive.

Mr. RABINOW. Do you have your own people to do that, or do you have outside consultants?

Mr. ZICARELLI. In the initial stage we try to make that decision ourselves, but once we get involved in seriously looking at something, we employ consultants. We use our present client company portfolio base to help us. We use people in the university or just about any place that we can find somebody who has some competency to evaluate these things.

Mr. RABINOW. Thank you.

Mr. ZICARELLI. I guess the record is not very perfect, even at that.

Mr. RABINOW. It never can be. You said that your growth rate was 50 percent per year?

Mr. ZICARELLI. Yes.

Mr. RABINOW. Does that include outside investments or is it internal growth? In other words, how effective are you in your own money investments?

Mr. ZICARELLI. The 50 percent compounded growth rate for the last 5 years has been basically a buildup of our own assets, starting with maybe $3 million in 1976. It has grown to $30 million.

Mr. RABINOW. That is not outside investments, most of that? Most of that is internal growth?

Mr. ZICARELLI. That is a result of the gains on investments that we made.

Mr. RABINOW. I can see that I have been in the wrong business all my life. [Laughter.]

Thank you.

Mr. GORE. Mr. Eastin?

Mr. EASTIN. Mr. Zicarelli, the question I have concerning the SBIC's is you mentioned development is your stage of investment at the market development stage after a product is developed, as I understand it.

Mr. ZICARELLI. Generally speaking, although, for example, in Cray Research the product was still being designed and built. We backed an individual whom we had some confidence in that could do the job.

Mr. EASTIN. So there is some involvement at the product development level?

Mr. ZICARELLI. Yes.

Mr. EASTIN. I have talked to several SBIC's myself and I was always told that, well, the marketplace—when it's in the marketplace we can do business assistance and those sorts of things, and that is where we would come in. Is that your general impression?

Mr. ZICARELLI. I think surely most of us would like to see things a lot more clearly defined than generally they come to us, and that is probably the reason we turn down most of the people we deal with.

Mr. RABINOW. In the case of Mr. Cray, he is the best computer designer in the world. He designed nearly all of the big computers for Control Data. You are playing a fairly good horse.

Mr. ZICARELLI. That's right.

Mr. EASTIN. So he would be your one person that you got into at the product development stage.

Mr. ZICARELLI. We have done others—not as successfully, I might add.

Mr. EASTIN. Mr. Templeman, you mentioned the amount of money that you are putting into—apparently it is information services? The $400?

Mr. TEMPLEMAN. Basically technology transfer. It is basically information services.

Mr. EASTIN. This is taking and sending the Government Printing Office reports and these sorts of things to technology that has been developed by the—under Government contract or by the Government to a mailing list?

Mr. TEMPLEMAN. Basically, we use computers and individual small business men will come to us with a technology problem and we'll use computers of Government developed technology and commercial development technology to provide abstracts of reports on these types of technology.

Mr. EASTIN. You are doing a Lockheed search?

Mr. TEMPLEMAN. Yes. And our program has not gotten the priority in SBA in the last few years it should have or probably will have. But then, based on what resources we have in that particular geographical region, we would go either assist this individual to understand the technology and possibly line him up with someone that can actually help him to implement it. Our services vary, depending on what our resources are, anywhere from doing a simple Lockheed search and having some individuals go out and assist.

Mr. **Eastin**. The Lockheed search is available at other than SBA. In a university library you can get it done for about $50.

Mr. **Templeman**. That's correct.

Mr. **Eastin**. I don't know if that is a place to be spending small business innovation funds or not. I guess that is the question I have.

Other than that, I would just like to say that I guess—and this is not cynicism, I apologize for that. I think I have heard again my charter does not fit.

Mr. **Gore**. That is not cynicism. That is the voice of experience. Mr. Reed?

Mr. **Reed**. I am not sure, so long as he precedes me, that I'm going to have any questions.

Mr. **Gore**. We'll change the order next time around.

Mr. **Reed**. I pass.

Mr. **Gore**. Mr. Mason?

Mr. **Mason**. Yes. I am really very impressed with everything I have heard. I want to ask you all a question that is probably far beyond what you have in mind; that if we are in an innovation crisis, and I guess we are, I wonder if there are other ways of looking at the thing. Now, maybe you are not the three people to think about this, but Napoleon one time gave out a prize for somebody to figure out how to can food and after a while a fellow came forward and told him how to can food. Somebody gave a prize for an airplane you could fly across the English Channel, pedaled like a bicycle, and so some people got together, solved the problems, and built the airplane.

It strikes me that if we all knew what to work on, we could work on the kinds of things that you people could support and we would all be happy and merry. Large corporations have a way around this thing, and what they do is try to find out what the consumer will buy and what the consumer's wants and needs are, and that's what they make. They do not make random stuff, they do not bring in 10,000 ideas for one that they will fund. They find which one needs funding, which one will sell.

I just wonder if it is not possible in Dr. Luff's innovation centers not to be so random but to be more specific. Maybe all of these funds which are either spent or withheld could be focused on prizes somehow. Maybe this is too mad an idea. It sounds as though it could be tried. What do you think of that, Dr. Luff?

Dr. **Luff**. I think the idea is sound. As a matter of fact, this was explored, the possibility of giving prizes. In conjunction with the traveling museum shows, it was felt that perhaps we could, in each location, have a prize fair and possibly involve the local inventor's clubs. Young people's groups would also be involved to have a show similar to the high school science shows and so forth, but on a much higher level, where prizes could be awarded for the outstanding invention or innovation.

Mr. **Mason**. That is still randomly pointed, right?

Dr. **Luff**. Right. I think what you are getting at is a terribly important point, if I could be permitted to comment very briefly on it. What you say about the corporations is very true. My experience with large corporations and with small corporations is that they focus their research and their development dollars on the kinds of things which are going to, of course, mean income to the corporation which is good commonsense. They would not focus on a random sort of an idea. As a matter of fact, many people have been fired for spending time on the job and off the job looking at things which were not in tune with whatever the corporation was looking at.

The other problem I see, and I am not being negative in either of these two comments because it is a fact of life, is that the innovation centers located at universities have a problem also. The problem there is what we might call conventional wisdom. Everybody knows "certain things." For example, I was an electrical engineer and as I remember my fundamental theory classes were a bunch of lies. Electricity is not an unknown force flowing like water from positive to negative. I have books to prove that that is true. We know today that that is not so; that this was conventional wisdom and taught for a good many years, and anybody who would come in with an idea contrary to that theory would immediately be laughed at.

I learned also as an engineer that the bumblebee can't fly. Aerodynamically, strictly, it is impossible. Therefore, every time I see one of these little buggers I know it is not true because I was taught that it just does not work that way. I think this is part of the problem, and in talking with John Eastin out in Des Moines when we visited his boilerplate factory which literally is in a little shed just off the fairgrounds, he pointed out to me that his invention had been turned down by major universities because it is contrary to conventional wisdom. In other words, everybody there knew it would not work because it is not the kind of thing which would work in terms of the theory which is currently being practiced. And I think this is one of the big problems with many, many inventions. They go contrary either to corporate policy or contrary to conventional wisdom or contrary to the administration or contrary to the dean's wishes or contrary to whoever has the final say.

This I see as one of the tremendous advantages that an innovation center has. It is not structured in any way to cause these kinds of things to happen. I do feel somewhat strongly that another big advantage is the randomness of the things being submitted. Nobody ever suggested to Ben Franklin that he get a pair of bifocals, and no one suggested to Thomas Edison that we needed a phonograph, and nobody suggested to Land that we needed polarization. These were things which were invented randomly. As a matter of fact, I think, Mr. Chairman, if you would permit me a minute, I would like to have John explain his invention because I think actually—this is my last point on this subject—it is very unique that his invention resulted as a couple of accidents and many inventions are the result of accidents. The genius is in recognizing the opportunity in the accident to see that here is a whole new theory, something contrary to conventional wisdom and then being able to exploit it. And this I think, John, is basically what happened with you; right?

Mr. Eastin. You can be philosophical about it, but I would like to think that two things were important in innovation and invention. One is you have to recognize that necessity, as for the bifocal example, is the mother of invention. And also you have to recognize that it's what we think we know that keeps us from learning in general. I was told by some very competent people that what we wanted to do would not work. I did not know any better than to think it would, based on my understanding as a biochemist. I was not a chemical engineer. I have a degree in biochemistry, not in engineering, and I can certainly testify that I don't know, because many things happened. I did discover the chemistry that allows me to do this system in a practical manner by observation. I guess—if you are not doing something, you don't have the chance to make that observation.

I feel that I took off knowing that I was going to take 1 year away from my profession and have an invention, and 8 years later losing the farm, and so on and so forth, we are finally to that place now. But I think if some sort of a mechanism is available—NSF does it on research now, who does it on development? Mr. Brown made the point, they have personal contact with people. The Center for Innovation came and—they sent a field man. He came and met, he looked and he saw, and then he said yeah, that makes sense. All of the agencies here said you know, it is impossible, or we do not have a charter that sets it. The cat needs to be put on somebody's back.

Mr. Templeman has decided not to fund the Center for Innovation. That is a horrendous decision, but that is my viewpoint. I can see his perspective on it. He has his charter. Who has one that is right?

Mr. GORE. Yes.

It is interesting how many of these inventions and developments are discovered by people outside of the established field wherein the invention arises.

Dr. EASTIN. Necessity.

Mr. MASON. Not necessity; it is observation. You're right. More new stars are found by amateur astronomers than professional astronomers. They are looking at different parts of the sky.

Dr. EASTIN. The reason I got involved in it, I am a physiological geneticist by training. I was studying the most important aspect of a farmer's cash input into a crop, nitrogen utilization. I was studying genetic systems for nitrogen utilization with the attitude that that could, if you can manipulate the genetic mechanisms to control efficiency of nitrogen utilization, you have a salable product. You look at a field of corn, it gives you some idea of the magnitude of the input of nitrogen fertilization. Every part of anhydrous ammonia represents a little over 22,000 Btu's of natural gas energy. If a man puts 200 pounds, which is common practice, on an acre of corn, and say he uses 8 gallons of diesel fuel as an example, over 70 percent of the direct energy input into that crop is nitrogen fertilizer.

The people in conservation say that this does not have energy implications. We got a letter from OERI [Office of Energy Related Inventions]. I have also been told that by the conservation people in DOE.

Mr. GORE. They are getting more and more eager to testify. The next panel, I am sure.

Mr. **Rabinow**. I would like to make one comment about awards. During President Nixon's administration, there was a program set up to give 10 $50,000 awards and medals to the greatest 10 innovators alive at that moment. The innovators were chosen. I know some of the ones who were chosen. I helped to select them. Draper's Laboratory was one, Mr. Land of Polaroid was another. They were choosing the great innovators, not inventors, innovators who started great new enterprises.

The medals were chosen, the rewards were chosen, the money delegated. And the story I got, and I cannot swear to this, but of the 10 innovators, 7 or 8 were Democrats and the awards were never given. There might have been other reasons, but the awards were not given. So, sometimes things enter into this game that have nothing to do with innovation. [Laughter.]

Mr. **Gore**. Do you have anything else to add, Mr. Rabinow?

Mr. **Rabinow**. Yes, sir, I do, but I think I would like to do it at another time. There were things said yesterday by very good men, things that bothered me. For example, do we have as many inventors as ever? Do we have innovators? The answer is that we do not. There is great evidence for this. There were other things said about which I made some notes, and if you have time at the end when everybody is through I would like to make some comments about some of those things. For example, why, generally speaking, large business does not support small business. Control Data is a very rare example.

I would like to tell you about the attitudes of big business toward patents. It is not what people think. Most big business does not like patents. I would like to quote important company officials without naming the companies.

I would also like to make some comments about support for small businesses in general and if they do better than they do now, will that save the U.S. technology? Without the cooperation of big business, without a change in their attitudes, their policies, I think we are a lost nation. I think we shall become a second Greece or Spain or other nations that have gone down the hill.

I think this is very serious. I think the whole capitalist system is at stake now because of the giant mergers. I would like to raise some questions about why it is possible for a company to spend $5 billion to buy another company for cash, but why they need a government grant to do R. & D. It bothers me very much when a radio company can buy a bank, while they need Government writeoffs, a bigger writeoff on R. & D. expenses. There is something rotten in Denmark.

Mr. **Gore**. I am glad I asked and we will try to make the time.

Mr. **Rabinow**. If there is time. I realize I talk too much, but that has been a fault of mine since I was a child. I am sorry, I cannot help it.

Mr. **Gore**. You have a receptive audience in this subcommittee. We are trying to make a useful record.

Were you through with your questions, Mr. Mason?

Mr. **Mason**. Yes; I was.

Mr. **Zicarelli**. May I comment on Mr. Mason's question?

Mr. **Gore**. Yes.

Mr. **Zicarelli**. It seems to me, in the free enterprise system, there is a prize, so to speak, for innovators and that is why most of them are struggling, and that is to make a lot of money based upon the ideas that they have and are trying to develop. And it seems to me that an additional incentive for those people could be to retain more of what they get, if we could reduce the capital gains taxes——

Mr. **Mason**. That's not the problem. The problem is the young fellow or the fellow without money, who has a great idea. It's not one who has it all worked out and can come to you. You're not working on the right problem.

Mr. **Zicarelli**. I am not sure that there aren't people that I could point to that have not started at the very bottom and that are at the primary stage and were able to achieve that success.

Mr. **Rabinow**. An inventor does not worry about capital gains when he invents. He starts worrying about that when he's making a lot of money, and then he gets a lawyer to help out. You do not invent because you are going to make capital gains. You invent because a problem hits you or because the boss asked you.

Mr. **Zicarelli**. And you pursue it because you're going to make money.

Mr. **Rabinow**. Capital gains tax is way in the future.

Mr. **Mason**. I do not think that money at all is the incentive. It is the result. Big difference.

Mr. **Rabinow**. I agree with Mr. Mason. It is the result. The pleasure, the respect of your peers, the better job you get. The money is there, but it is not the overriding thing to an inventor, at least the inventors I know and I know a great many. They do not say I am going to invent because I am going to make a lot of money.

Mr. **Mason**. It is like you do not have intercourse to make babies. It is the same thing. [Laughter.]

Mr. **Gore**. We're back to Benjamin Franklin again. [Laughter.] Mr. Eastin?

Dr. **Eastin**. In this situation of rewards for invention, I feel, you know, Mr. Tibbitts from the NSF and that program, I as an inventor, if I have the opportunity and the resources to develop an idea, granted it is secondary where there is a market and I would like to put that off on somebody else. Unfortunately you cannot, but a program like that to me, one of your problems is bringing inventors into the mainstream. I left a very comfortable situation and it took me a long time to make that decision. It took 2 years of working as a professional researcher and thinking about this project and having it turned down by the board twice, because I had more to do in the conventional program that was necessary. And I could understand that, you know. That was a legitimate reason.

But if there had been a program like the NSF program, you bet your bottom dollar I would have had my application into it, and I might have made it a lot sooner—the decision, and I suspect there are a lot of other secure people, professional people, who have a capacity, have an idea and if they had a mechanism to develop it outside of the corporate boardroom or the university patent system, NBS or whatever, they might take that flyer. Necessity, need, whatever you call it, I think that is what stimulates invention. The guy is sitting there and because of his overall perspective of a problem, he says I can fix something that will do that and I can make a better mousetrap or a wigit or whatever. He would take the risk if he had the program.

Mr. GORE. All right. I think our subcommittee's innovation of having this panel of questioners has been validated by the record that is being compiled. Did you have other questions, Mr. Mason?

Mr. MASON. No; I didn't. Thank you.

Mr. GORE. This is very interesting, and I hope that our witnesses from the respective Government agencies can take due note of the insights that our inventor panel has been offering. Thank you all very much. We are going to go to our third panel now. We appreciate your participation.

We would like to call our final panel of this 2-day hearing. Mr. George P. Lewett, Chief of the Office of Energy Related Inventions at NBS; Frank DeGeorge, Deputy Assistant Secretary for conservation and renewable energy with the Department of Energy; and David Mello, Acting Director of the inventions division at the Department of Energy. Gentlemen, without objection, the entire text of your prepared statements will be included in the record at this point and we invite you to proceed with your oral presentation of any or all of it as you see fit.

Mr. Lewett, please begin.

STATEMENT OF GEORGE LEWETT, CHIEF, OFFICE OF ENERGY RELATED INVENTIONS, NATIONAL BUREAU OF STANDARDS; FRANK DeGEORGE, PRINCIPAL DEPUTY ASSISTANT SECRETARY, CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY; AND DAVID MELLO, ACTING DIRECTOR OF INVENTIONS DIVISION, DEPARTMENT OF ENERGY

Mr. LEWETT. I see two inventors in the process of taking their coats off. I think it is appropriate that I go first, seeing that NBS conducts the first half of this two-part program in which the DOE and NBS work very closely together.

The energy-related inventions program started in April 1975, and I personally have been associated with it right from the beginning. I was responsible for basic design and initial implementation of the evaluation process and participated in the overall program design. My submitted testimony provides a full description of the program, information on results, and statistics on performance, currently and over the entire 6-year period. In my remarks now I would like to summarize, and to comment briefly on what I consider to be major features and unique aspects of the program, particularly in the context of this hearing.

The purpose of the energy-related inventions program is to encourage and support energy-related inventions by independent inventors and small businesses. The program, as I mentioned, has two parts. Inventions are evaluated by my office in the National Bureau of Standards which is part of the Department of Commerce. Support, usually in the form of a grant, is provided by the Department of Energy for inventions that we at NBS recommend to them as promising.

Almost all inventions that are submitted to the program come from individuals and small businesses of less than 100 employees.

They submit a 2-page evaluation request form together with material which describes the invention and which points out how and why the inventor feels that it warrants Government support. When we receive the submission we first review it from a nontechnical viewpoint, to make sure that the invention is within program scope--that is, it is energy-related and not nuclear in nature—is sufficiently well described to permit evaluation and is not obviously fallacious. Perpetual motion machines fall out at this point.

If we accept it after this initial review, then we initiate a two-stage evaluation process. The first stage in the evaluation is a technical screening in which we get a series of brief opinions from our own staff evaluators, from other Government scientists or engineers, and/or from consultants and contractors. If the invention is rated as "promising" in this first stage, then we initiate what we refer to as the second stage of evaluation. By "promising," we mean that the invention seems to be technically feasible, has significant energy conservation or supply potential and is economically and commercially practical.

In second stage evaluation a more in-depth analysis is conducted which results in a formal report. If the second stage evaluation confirms the earlier finding of "promising", then the disclosure and the evaluation results are forwarded with the recommendation for Government support to the Department of Energy.

Throughout the process the inventor is kept informed of the status of the evaluation. When the evaluation is complete, after either first or second stage, a letter of notification is sent to the inventor reporting the results of the evaluation. If a second stage evaluation had been conducted, a copy of the formal evaluation report—which is usually developed by a consultant—is also sent to the inventor.

On receipt of the NBS recommendation, DOE contacts the inventor and initiates the procedures designed to establish developmental or other support requirements and provide the appropriate Government assistance. The intent is to award a grant in the case of each recommendation.

It should be noted that there are no fixed procurement cycles in the operation of the program. An inventor can submit his invention for evaluation at any time. When we evaluate it, we evaluate it on its individual merit rather than on how it compares with other inventions submitted in the same time period. The process of evaluation and grant award is a continual one rather than a batch process. It differs, for example, from the NSF small business R. & D. program which is a batch process. They operate in the conventional manner with a fixed procurement period in which qualified submissions are rated and ranked, and a group of awards made, competitively selected according to the ranking.

The program has been operatiang for 6 years. Currently it is receiving about 200 inventions a month, and these are being processed at the same rate or better. We have continually 400 to 500 inventions that are in the process of evaluation.

The number of inventions that are recommended and funded is averaging about three inventions per month.

We are actually operating an input-output continual flow process, which is turning out worthwhile new energy products or new technology at the rate of three items a month. The flow is very steady and the "pipeline" is full.

We have success stories. Some are noted in the formal testimony, and I think the DOE representative will discuss some of those. These need to be better documented and we are paying more attention to this now than we have in the past. We are certainly seeing cases in which the program support has resulted in some very significant energy, societal and economic benefits. When we learn how to measure success in this business, I am sure we will find the continually accumulating benefits to be substantial.

I would like to comment on certain specific features and unique aspects. First, as Roland Tibbetts pointed out, there are major differences in our programs. One difference is that we deal with inventions rather than with proposals to do research and development. For NBS to do an evaluation, the submission must present a developed idea or one ready for development. It does not have to be patented. It has to be one, however, for which an application can be defined and for which claims for performance can be made and checked. A proposal to explore a promising line of research which might result in an invention would not be within program scope. In other words, it is not covered in our charter.

Another difference is that the capability and the track record of the inventor or the company are not factors in the evaluation. They only become of interest when we recommend, and then they are of interest to the Department of Energy.

We find that only a small portion, about 1.3 percent, of the inventions submitted can be recommended. Because the proportion is so small we take pains to make sure that we do not miss recommendable inventions. If we are recommending three or four inventions a month, just finding one more adds 25 percent to our output. Our focus therefore, is entirely on the policy that we cannot afford to miss one that is recommendable. We are in the business of finding good inventions, not of finding reasons to turn down requests for support.

One most important method of insurance against missing good inventions is what we call our "open door" policy. That is, when an inventor is turned down, we never close the file. We permit and encourage him to rebut or add new information and to request reconsideration or reevaluation. There are cases on file that show continual correspondence with us for the past 5 years. There is one item that we recommended after a 3-year period, in which there were continual changes in design and continual requests for reconsideration throughout the 3 years. This policy has proved to be of value. Statistically, we can document that 12 percent of our recommendations come from cases like this, that is, where we first turned down the invention, the inventor came back at us with a clarification or a modification, and we ended up recommending.

There are many by-products of the program which I personally feel will prove of considerable benefit in the long run. However, I think one of the most important things that I would like to bring to your attention is something which was brought up by Professor Shapero yesterday: The fact that we know so little about the innovation process. The program is dealing in a very intimate way with a very particular part of the innovative population of the United

States. We have heard that "small" inventors contribute so much to innovation, but we really do not know too much about them. Most of our management science studies on the conduct of R. & D. are focused on the large corporate laboratories. In this program, we have basically a test bed established in that we are collecting quite a bit of data about what the independent inventor and the small business company is doing, the types of innovations he comes up with, where he is located, and how effective he actually is.

That we have success stories is certainly pointing out that the independent inventor is still a potent force in our economy. And what this program is telling us is that he can be a greater force. As a result of the data that we have been collecting, we have initiated a number of supplementary activities which are programmatically oriented to increase the number and the quality of inventions coming into us, into the National Bureau of Standards. These are described in the formal testimony and I wish to call your attention to them.

It must be noted that we have no control over the quality of the inventions sent to us. We can only receive the inventions, evaluate them, and "tell it like it is." However, we can try to do something about the invention process itself. That is, we can provide services and facilities to help the independent inventor improve his innovative capabilities so that more inventions and higher quality inventions can be submitted to us.

Thank you very much.

[The prepared statement of Mr. Lewett follows:]

U.S. DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

STATEMENT OF GEORGE P. LEWETT
CHIEF, OFFICE OF ENERGY-RELATED INVENTIONS
NATIONAL BUREAU OF STANDARDS
BEFORE
THE COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
JULY 22, 1981

Mr. Chairman and Members of the Committee:

I appreciate this opportunity to discuss the National Bureau of Standards' efforts to assist the energy research and development efforts of small businesses. My discussion will focus on the activities of the Bureau's Office of Energy-Related Inventions (OERI) in evaluating energy inventions, in conducting supplemental activities to increase the number of energy-related inventions submitted, and in coordinating our efforts with those of the Department of Energy's (DOE) Energy Inventions Program Office.

OVERVIEW

My name is George P. Lewett. I am Chief of the Office of Energy-Related Inventions (OERI) at the National Bureau of Standards (NBS) in the

Department of Commerce. I have been Chief of OERI since the office was established in March 1975. I hold a BS degree in Physics from Syracuse University and an MS degree in Applied Statistics from Rutgers University. Before joining NBS in 1973 I worked in industry for 22 years as an engineer with both large and small firms.

The following material describes the Energy-Related Inventions Program and discusses topics listed by the Committee as being of interest in this hearing. The topic of funding limitations, however, will be discussed by the DOE representative at this hearing. Since the Program is totally funded by DOE, NBS is totally dependent upon DOE for support. While NBS operates independently in many respects, our effectiveness and ability to perform is contingent upon the level of funding we receive from DOE.

INTRODUCTION

The Energy-Related Inventions Program was established by Congress under the Federal Nonnuclear Energy Research and Development Act of 1974 (P.L. 93-577). The purpose of the Program is to encourage and support energy-related innovation by independent inventors and small businesses. The Program has two parts. Inventions are evaluated by the Office of Energy-Related Inventions (OERI) in the Department of Commerce's National Bureau of Standards (NBS). Support, usually in the form of a grant award, is provided by the Department of Energy (DOE) for inventions identified by NBS as promising.

The Program focuses on individual enterprise in technological innovation. Experience indicates that significant new developments in technology can come from inventors outside the large corporate R & D laboratories. However, if the full innovative potential of non-corporate inventors is to be realized, particular attention needs to be given, in programs such as this, to establishing the credibility of their inventions.

PROGRAM OPERATION

Evaluation (NBS-OERI). OERI has received a total of 16,780 evaluation requests since the inception of the Program in April 1975. Decisions have been made on 16,235; 545 are currently in the process of evaluation. To date, 175 inventions have been recommended to DOE.

Government grant programs generally operate on a fixed procurement cycle. Applications are accepted only at certain times and are processed in a batch with the rest of the group submitted during the procurement period. The Inventions Program differs in that there is no fixed procurement cycle. Evaluation requests can be submitted at any time, and requests are processed individually. Thus, the process is continual as are the decisions.

Evaluation requests averaged 180 per month over the past 6 months. Decisions have been exceeding the number of evaluation requests received. Therefore, the number of evaluations in process has decreased steadily so that the backlog is at a minimum. Processing time for evaluated inventions has also been decreasing, currently averaging 22.6 weeks. The number of recommendations forwarded monthly to DOE averages between 3 and 4.

Further detail on the evaluation process is contained in Attachment 1.

Support (DOE). Of the 175 inventions NBS recommended to DOE, DOE has awarded, or is awarding, grants or contracts to 95 and other-than-financial assistance to 5. DOE could not provide assistance for 17 of the 175, and the remaining 58 are still under review by DOE to determine the nature and extent of support required.

DOE awards to date total approximately $7.0 million. The average award is $74,000 but has ranged from $18,000 to $200,000. Further detail on the support process and the inventions recommended is provided in Attachment 2.

PROGRAM OUTPUT IN SUPPORTED INVENTIONS

The preceding statistics describe the operation of a process which is yielding a steady stream of new energy-related products or technologies at the rate of 3 to 4 items per month. DOE funding to support development of the new products is going generally to individuals and companies of less than 100 employees, i.e., the lowest end of the small business spectrum.

Potential energy impact of the new products is seen to be significant. Of equal importance are economic and societal benefits derived through new business start-up or encouragement, principally in the creation of new jobs and new business income. Also, 30 percent of the recommendations are industrial process improvements which could impact industrial productivity.

Brief descriptions of some NBS-recommended inventions follow. These inventions are currently being supported by DOE. While the results are not yet in, the inventions look particularly promising for their energy producing or conserving potential.

"Processing Recovery of Aluminum," Paul J. Cromwell, Cromwell Metals, Inc., Buffalo, New York.

This invention is a mechanical process for separating aluminum metal from the dross, a waste product formed on the surface of molten metal. The Cromwell process which is operated at room temperature, appears to recover about 90 percent more aluminum from a given amount of dross than other known processes for recovering aluminum from the dross.

A Department of Energy grant in the amount of $158,029 was awarded to optimize the design of a practical and economic production facility.

"Mine Brattice," James Allen Bagby, Bagby Brattices, Inc., Greenville, Kentucky.

This device is a reusable brattice partition used to form ventilation passages in coal mines. The Bagby Brattice is claimed to be quick and inexpensive to install and seals better than present stoppings. An improved air seal reduces pumping power requirements and increases mine safety. Further, the workmen formerly assigned to building brattices are released for coal production, thus improving productivity. Costs attributed to mine ventilation are second only to labor costs in mining operations.

A Department of Energy grant in the amount of $62,664 was awarded to provide for the fabrication and installation of 25 prototype brattices in a southern Illinois, underground coal mine of the Peabody Coal Company. Data were to be collected over a two and one-half year period to measure performance of the brattice.

The Peabody Coal Company was so impressed with the performance of the Bagby Brattice that the data collection period was substantially reduced. (Early in the test it was proven that these brattices were reusable and would perform as well in the second location as they would in the first; thus the test was ended.)

"Solarspan," George E. Mattson, John Mattson (inventor), Advanced Solar Components, Inc., Brockton, Massachusetts.

Mr. Mattson has devised an all-plastic "black liquid" solar collector. The design of the collector offers provisions for freeze and overheat protection; the plastic, relatively light in comparison to conventional metal collectors, can be molded to give good structural properties with thin sections. The collector consists of four sheets of vacuum-formed Uvex (Eastman Kodak) Plastic in a panel, shaped to contain the working fluid; outlet tubes are molded into the shaped design.

A Department of Energy grant for $98,700 was awarded to develop a prototype of an improved design and to demonstrate the retrofit application of a mass-producible, plastic-molded collector in residential and commercial buildings.

At the 9th Annual World Fair for technology exchange, held March 10-13, 1981, in Atlanta, Georgia, Mr. Mattson's invention was awarded third place in the Inventors' Division for "Significant Achievement in Technological Development."

"Leavell, Vibrationless, Low Noise, High Efficiency, Pneumatic Percussion Tools and Air Compressor Systems," Floyd R. Anderson, Vast Research Company, Bella Vista, Arkansas.

The invention is a design concept for pneumatic tools. Heated air can be utilized by the tool directly after compression without the after-cooling characteristic of conventional compressor-tool systems. Higher temperature inlet and lower pressure exhaust increases energy efficiency over conventional-design tools.

A Department of Energy grant for $76,675 was awarded to design, build, and test six pneumatic tools. The results of these independent tests to analyze energy input and output, rate of work, noise, and vibration, clearly demonstrate the superiority of Mr. Anderson's systems over conventional tools.

The potential for energy savings is up to 70 percent for a specific application. The tools, which are now in production, are applicable in all construction activities using percussion tools.

"Air-Cooled Compressor Heat Recovery and Heat Circulation System Plus Ambient Air Filter and Air Cleaner for Same Compressor," Mr. Kenneth A. Stofen, Ken Stofen Associates, Racine, Wisconsin.

The inventor has developed an environmental barrier or cabinet to contain the heat exchange surfaces and air intake for air-cooled systems used in generating compressed air.

A Department of Energy grant in the amount of $53,000 was awarded to Mr. Stofen to design and build prototype cabinets and to gather data on the operation of his system. Data collected to date by the inventor reflect significant savings to the user due to recovery of waste heat.

At the 9th Annual World Fair for Technology Exchange, held March 10-13, 1981, in Atlanta, Georgia, Mr. Stofen's system was awarded first place in the Industry Division for "Significant Achievement in Technological Development."

SUPPLEMENTAL ACTIVITIES - NBS

In addition to performing evaluations, NBS has responsibility for initiating and conducting activities which are designed to increase the number and quality of energy-related inventions submitted. Current major activities in this category are described below.

National Innovation Workshops (NIW). This series was initiated in 1980 to provide practical guidance and information to inventors and innovative small businesses throughout the Nation. Each NIW features workshops on topics such as: turning ideas into inventions, patenting and protection, licensing and selling inventions, and new business start-up. The attendees are informed about, and materials distributed on, sources of consultation, financial assistance, and technical and socio-economic information. The general theme is to encourage innovation in energy technologies.

In 1980, NIWs were held in San Francisco; Boston; Atlanta; Arlington, Texas; and Philadelphia. In February and March 1981, Workshops were held in Denver and Minneapolis. Indianapolis and Seattle NIWs are scheduled for July 17-18 and August 21-22, 1981, respectively. One other is planned for calendar 1981. NIW attendance has ranged from 250 to 500.

Inventor Information Resource Centers. OERI's experience indicates that independent inventors and small businesses do not make effective use of national technical information resources. To address this problem, OERI, in September 1980, awarded grants to Patent Depository Libraries in Sunnyvale, CA; Boston, MA; and Atlanta, GA; to establish Inventor Information Resource Centers. The Centers are being developed to encourage use of computerized data bases by the non-corporate inventor; assemble collections of books, periodicals, and other instructional materials on invention and innovation; conduct instructional programs on searching technical literature and on associated subjects; provide a repository of information on Government and private sector programs of interest to the inventor or innovative small business; and support technical personnel who provide inventors with technical consultation or assistance.

The three Centers are in different stages of development. The Atlanta Center is furthest advanced; it has conducted four workshops on technology searching. An interagency committee, chaired by OERI, has been formed to oversee this pilot project; membership includes representatives from the Patent and Trademark Office, Small Business Administration, National Technical Information Service, DOE Technical Information Center, and the NBS Library Division.

Inventor Organization. OERI is actively supporting formation of, and communication among, inventor organizations. The objective is development of an organizational network which will serve as a channel of communication for disseminating information to inventors. A grant was awarded in September 1980 to the American Association of Engineering Societies to establish the feasibility and the potential value of a National Congress of Inventor Organizations which would operate as an "umbrella" organization with local or state groups as members.

SUPPLEMENTAL ACTIVITIES - DOE

In addition to processing recommendations from NBS, DOE has the responsibility for conducting activities which are designed to foster wide use of the new technology emerging from the Program. Wide use is required if the energy-saving potential of the supported inventions is to be realized. Current activities are discussed below.

Invention Exhibitions. For the third successive year, under the aegis of the DOE/NBS Inventions Program, a group of DOE grantees were selected to exhibit their supported inventions at the 1981 Annual World Fair for Technology Exchange (Tech Ex '81). The purpose of this annual fair is to bring new technologies to the marketplace by bringing inventors and investors together in order to negotiate licenses or sales. Tech Ex attracts a representative sample of the world-wide technology innovation market. At Tech Ex '81, three of the Program's inventors received special honors for the high quality of their inventions.

Program Output Promotion. DOE activities in this category aim at bringing the Program to the attention of private sector investors. These activities are also intended to reduce the DOE involvement in commercialization. In recent months, interest has been expressed in the Program output by a number of large companies looking for new products. Such companies recognize the creative potential of the individual and the small company but are reluctant to engage in the laborious task of screening and searching on the scale required to ensure success.

ATTACHMENT NO. 1 to: Statement of George P. Lewett Before the Committee on Science and Technology, U.S. House of Representatives, July 22, 1981.

NBS EVALUATION PROCESS DESCRIPTION AND STATISTICS

Operational Procedures

There are three principal steps in the evaluation process used by the National Bureau of Standards' Office of Energy-Related Inventions (OERI). In the first step, Disclosure Review and Analysis, invention disclosures are either accepted or rejected for evaluation, depending upon whether or not the invention is within program scope and the disclosure is sufficiently well-prepared to enable evaluation. If accepted, a two-stage evaluation is initiated.

First-Stage Evaluation is a technical screening in which brief opinions are obtained from OERI staff evaluators, other Government scientists or engineers, or consultants or contractors. If the invention is rated as "promising" in this first-stage, Second-Stage Evaluation is initiated. ("Promising" means the invention seems to be technically feasible, have significant energy conservation or supply potential, and is economically and commercially practical.)

In Second-Stage Evaluation a more in-depth analysis is conducted, resulting in a formal report. If Second-Stage Evaluation confirms the finding of "promising," the disclosure and evaluation results are forwarded with a recommendation for Government support to the Department of Energy.

Throughout the process, the inventor is kept informed of the status of the evaluation. When evaluation is complete after either first- or second-stage, a letter of notification is sent to the inventor reporting the results of the evaluation. If Second-Stage Evaluation had been conducted, a copy of the formal evaluation report is sent to the inventor.

Performance Statistics

Figure 1 shows OERI's experience to date, namely that 49 percent of disclosures received are acceptable for evaluation; 8 percent of these are found sufficiently promising in first-stage to warrant second-stage evaluation; and 31 percent of the inventions in second-stage are recommended. The "expected yield" of the evaluation process is defined as the product of these three percentages, 1.3 percent. It is assumed that when OERI has processed the 16,780 evaluation requests received as of March 31, 1981, approximately 1.3 percent or 218 will have been recommended. To date, 175 of the 218 have been identified and forwarded to DOE.

Figure 2 represents the statistics for the three steps in the evaluation process for the 6-month period beginning September 1980. Figures 3 and 4 show results for groupings of technology subject areas and for each of the fifty states.

Time to process an evaluation request is also a significant measure of performance. This consists of the amount of time which elapses between OERI's receipt of an evaluation request and OERI's mailing a letter to the inventor notifying him of the results of the evaluation. Average processing times are as follows:

	Average Processing Time in Weeks for Letters Mailed in Period:					
	1/78 thru 6/78	7/78 thru 12/78	1/79 thru 6/79	7/79 thru 12/79	1/80 thru 9/80	10/80 thru 3/81
Not accepted for evaluation	5.4	2.7	3.3	6.0	3.5	3.0
Accepted and evaluated	35.9	35.3	33.4	22.3	23.6	22.6

NBS INVENTION EVALUATION PROCESS STATISTICS

APRIL 1975 THRU MARCH 31, 1981

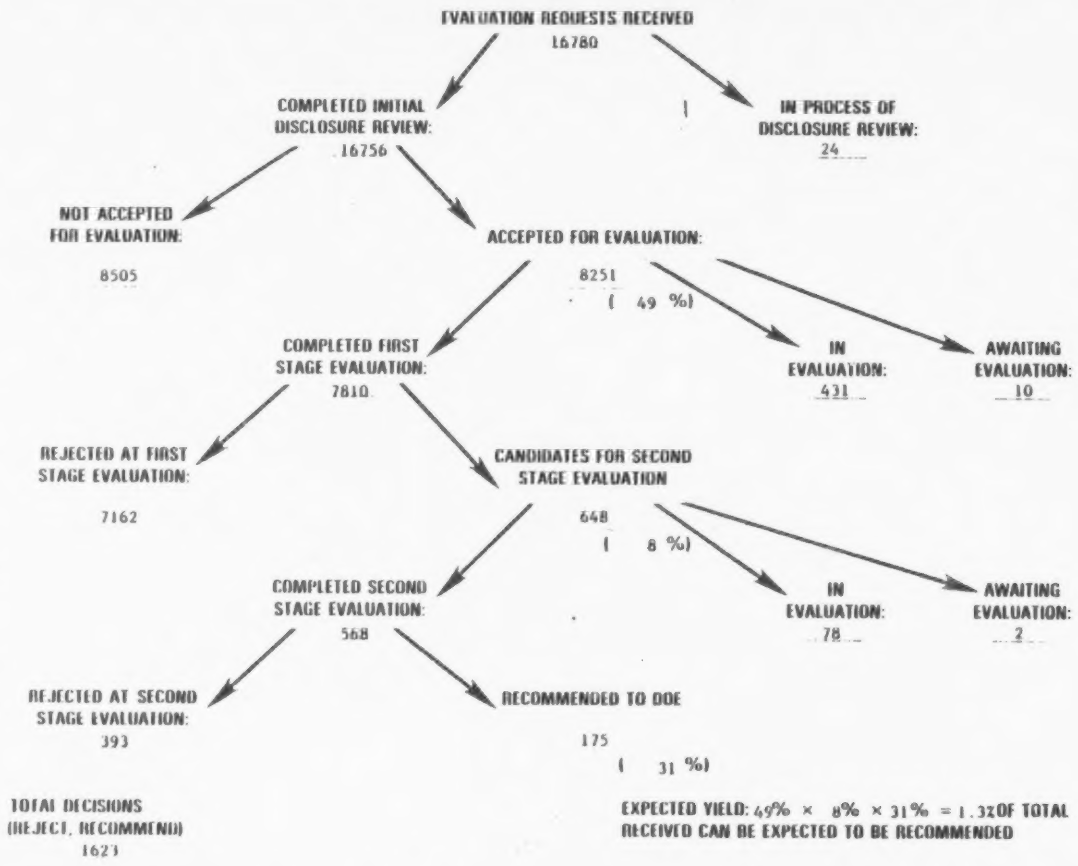
EVALUATION REQUESTS RECEIVED
16780
COMPLETED INITIAL DISCLOSURE REVIEW:
16756
IN PROCESS OF DISCLOSURE REVIEW:
24
NOT ACCEPTED FOR EVALUATION:
8505
ACCEPTED FOR EVALUATION:
8251
(49 %)
COMPLETED FIRST STAGE EVALUATION:
7810
IN EVALUATION:
431
AWAITING EVALUATION:
10
REJECTED AT FIRST STAGE EVALUATION:
7162
CANDIDATES FOR SECOND STAGE EVALUATION
648
(8 %)
COMPLETED SECOND STAGE EVALUATION:
568
IN EVALUATION:
78
AWAITING EVALUATION:
2
REJECTED AT SECOND STAGE EVALUATION:
393
RECOMMENDED TO DOE
175
(31 %)
TOTAL DECISIONS (REJECT, RECOMMEND)
1623
EXPECTED YIELD: 49% × 8% × 31% = 1.3% OF TOTAL RECEIVED CAN BE EXPECTED TO BE RECOMMENDED

FIGURE 1: Cumulative Flow Statistics As Of March 1981

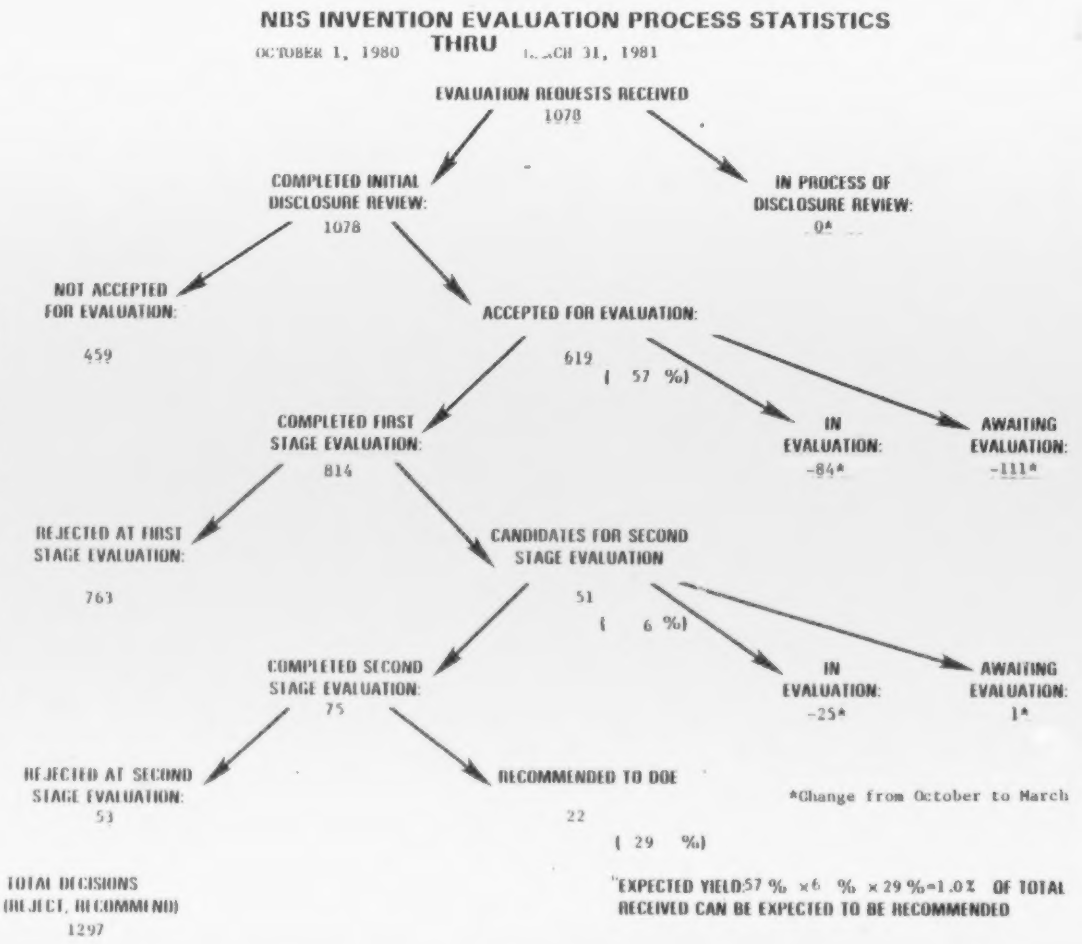
NBS INVENTION EVALUATION PROCESS STATISTICS
OCTOBER 1, 1980 THRU MARCH 31, 1981
EVALUATION REQUESTS RECEIVED
1078
COMPLETED INITIAL DISCLOSURE REVIEW:
1078
IN PROCESS OF DISCLOSURE REVIEW:
0*
NOT ACCEPTED FOR EVALUATION:
459
ACCEPTED FOR EVALUATION:
619
(57 %)
COMPLETED FIRST STAGE EVALUATION:
814
IN EVALUATION:
-84*
AWAITING EVALUATION:
-111*
REJECTED AT FIRST STAGE EVALUATION:
763
CANDIDATES FOR SECOND STAGE EVALUATION
51
(6 %)
COMPLETED SECOND STAGE EVALUATION:
75
IN EVALUATION:
-25*
AWAITING EVALUATION:
1*
REJECTED AT SECOND STAGE EVALUATION:
53
RECOMMENDED TO DOE
22
(29 %)
*Change from October to March
TOTAL DECISIONS (REJECT, RECOMMEND)
1297
"EXPECTED YIELD:57 % ×6 % × 29 %=1.0% OF TOTAL RECEIVED CAN BE EXPECTED TO BE RECOMMENDED

FIGURE 2: 6-Month Period Flow Statistics

EVALUATION PROGRESS REPORT BY INVENTION CLASS AS OF MARCH 31, 1981

Classification	Evaluation Requests Received	Accepted for First-Stage	Completed First-Stage	Accepted for Second-Stage	Completed Second-Stage	Recommended	% of Total Received	% of Total Expected to be Recommended**
Fossil Fuel Production	356	261	246	59	54	17	2.1	5.5
Direct Solar	1981	1078	1016	67	57	11	11.8	0.7
Other Natural Sources	2463	962	912	56	49	12	14.7	0.6
Combustion Engines & Components	1898	1161	1095	75	66	11	11.3	0.7
Transportation Systems, Vehicles & Components	1422	830	791	50	42	11	8.5	1.0
Buildings, Structures & Components	2824	2061	1945	118	105	38	16.8	1.6
Industrial Processes	860	661	623	150	137	51	5.1	7.2
Miscellaneous	2043	1165	1107	73	62	22	12.2	1.3
Out of Scope & Unclassifiable	2920	79	77	0	0	0	17.4	0.0
TOTALS	16767*	8258	7812	648	572	175	100.0	1.3

FIGURE 3: Subject Area Statistics

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* Excludes 14 not yet classified. (Disclosure Review not completed).

** For Example: Fossil Fuel Production $\frac{261}{356} \times \frac{59}{246} \times \frac{17}{54} \times 100 = 5.5\%$

EVALUATION PROGRESS REPORT BY STATE AS OF MARCH 31, 1981

	Evaluation Requests Received	Completed Disclosure Review	Accepted for First-Stage	Completed First-Stage	Accepted for Second-Stage	Completed Second-Stage	Recommended
Alabama	165	164	80	76	0	0	0
Alaska	36	36	20	20	0	0	0
Arizona	245	245	152	141	18	15	1
Arkansas	94	94	41	40	5	5	2
California	2251	2248	1111	1056	95	82	23
Colorado	336	335	224	215	30	29	1
Connecticut	341	341	188	181	17	17	9
Delaware	41	41	25	23	2	2	2
District of Columbia	74	74	38	35	7	7	0
Florida	962	961	464	446	18	17	6
Georgia	213	213	100	96	8	7	2
Hawaii	65	65	28	24	1	1	1
Idaho	64	64	42	40	3	3	3
Illinois	562	561	271	255	15	14	5
Indiana	266	266	131	123	8	7	2
Iowa	112	112	60	60	2	2	2
Kansas	198	198	86	83	3	2	1
Kentucky	149	149	62	57	4	4	3
Louisiana	177	177	80	77	8	7	3
Maine	99	99	50	48	5	2	1
Maryland	451	450	275	257	25	24	6
Massachusetts	682	682	317	304	34	30	11
Michigan	608	608	287	267	19	18	6

FIGURE 4: State Statistics

Minnesota	296	296	146	140	10	8	4
Mississippi	110	109	32	32	3	2	0
Missouri	335	335	168	164	7	7	3
Montana	51	51	23	21	2	2	0
Nebraska	91	91	44	41	6	4	1
Nevada	82	82	36	35	3	3	0
New Hampshire	100	100	59	53	13	10	4
New Jersey	609	609	330	303	29	26	5
New Mexico	137	137	58	57	4	2	1
New York	1288	1287	686	642	48	46	15
North Carolina	284	284	137	129	4	3	1
North Dakota	29	29	10	10	1	1	1
Ohio	542	541	265	254	22	18	7
Oklahoma	215	215	97	93	11	10	1
Oregon	352	351	152	144	13	13	3
Pennsylvania	748	747	364	343	37	33	13
Rhode Island	59	59	21	20	3	3	0
South Carolina	107	107	47	41	1	0	0
South Dakota	30	30	17	17	2	2	1
Tennessee	263	263	109	100	5	3	0
Texas	711	711	344	329	24	18	9
Utah	142	142	51	45	6	6	4
Vermont	64	64	43	42	6	4	0
Virginia	352	352	173	165	20	18	5
Washington	396	396	184	178	9	8	2
West Virginia	50	50	14	14	0	0	0
Wisconsin	309	309	140	135	8	8	3
Wyoming	32	32	12	8	0	0	0
Territories	38	38	16	14	1	1	0
Foreign Countries	767	766	348	319	23	18	3
TOTALS	16781	16767	8258	7812	648	572	176

FIGURE 4: (Cont.)

ATTACHMENT NO. 2 to: Statement of George P. Lewett Before the Committee on Science and Technology, U.S. House of Representatives, July 22, 1981.

DOE SUPPORT PROCESS DESCRIPTION AND STATISTICS

Introduction

Inventions forwarded by the National Bureau of Standards' (NBS) Office of Energy-Related Inventions (OERI) to the Department of Energy's (DOE), Invention Division (ID) are recommended by OERI as "technically valid and worthy of consideration for Government support" under the NBS/DOE Inventions Program. The OERI report furnished with the letter of recommendation qualifies the recommendation and provides guidance to DOE and the inventor in determining the nature and extent of support to be given.

Inventions recommended by OERI may be at any stage of development; some may be conceptual, others at the laboratory testing stage, while others may be in production or may be in the process of being marketed. Support to be furnished will depend largely on what is required to move invention development forward or to resolve the question of whether development should continue; the latter question is of particular interest where the NBS recommendation is based on data furnished by the inventor and the recommendation is qualified by an expressed need for data validation under controlled testing conditions.

The intent by DOE in each case is to accept the NBS recommendation and provide the appropriate support. However, there will be (and have been) cases in which DOE cannot or will not provide support. The principal considerations which DOE uses in determining support are:

- agreement between inventor and DOE on nature and extent of support.

- capabilities of the inventor and/or the company involved.

- duplication of prior or existing DOE funded efforts.

It should be noted that no further technical evaluation is performed by DOE, beyond that of NBS', and that availability of support funds has not been a problem to date. DOE does reserve the right to question and reject the NBS recommendation and to restrict support because of funding considerations.

Each case is decided on the basis of individual merit and need. If DOE decides to support the inventor, support can include: a grant, a contract, or direct assistance of a technical or business nature. DOE's objective is that, at the completion of this support, the inventor will be in a position to do one or more of the following:

- Compete effectively in obtaining contracts from other sources (including existing government programs), to permit further development of the invention.

- Assemble, with confidence of success, the people and capital necessary to produce and market products derived from the invention through a business enterprise in which the inventor is a major participant.

- Negotiate arrangements with an existing company that will develop the inventor's product for commercialization.

Operational Procedures

On receipt of the recommendation from NBS, DOE contacts the inventor, informs him or her on details of the support procedures, and requests him or her to prepare a proposal for funds or other support desired. ID works with the inventor in proposal preparation to ensure effective review of support options and to develop a satisfactory statement of work and support plan. The recommendation is also reviewed by other appropriate DOE programs to insure against duplication and to determine other program interest. Decisions are then made on whether or not support will be provided as well as the nature and extent of the support.

If financial support is to be provided, DOE initiates procurement action. ID monitors progress of the procurement action and helps to expedite until the award is made.

While financial or other support is being provided, ID continues monitoring and maintains a status report for use by both DOE and NBS. The report lists each recommendation and shows its status in accordance with the definitions of Figure 1. The complete list, with status as of March 31, 1981, is included at the end of this Attachment.

Performance Statistics

The chart in Figure 2 depicts progress in processing the recommendations received from NBS/OERI since the inception of the program.

The number of NBS recommendations being supported is better than 85 percent of those received (100 ÷ 117). Non-support by DOE does not mean rejection of, or disagreement with, the NBS recommendation; in the majority of cases, support was either not feasible or not wanted by the inventor. Reasons are given in the detailed status report.

Of the inventions supported, 95 percent (95 ÷ 100) are being supported financially. To date, a total of $7.0 million has been obligated on 95 inventions either by grant or contract. This amounts to an average of approximately $74,000 per award.

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

PHASES IN DOE's SUPPORT PROCESS

Analysis I	Recommendation received from NBS and processed, file initiated, etc. Inventor requested to submit description of proposed work. Receipt of inventor's preliminary proposal initiates next stage.
Analysis II	Invention Division (ID) formulates options for support, based upon information received from NBS, DOE program staff, and inventor. Determination of options initiates next stage.
Decision Phase	Statement of Work derived from options. Inventor requested to submit supporting documents for procurement action. ID prepares purchase request or makes arrangements for other assistance.
Other Assistance	Laboratory testing or business planning assistance.
Procurement	Step-by-step processing of all documents leading to an award of grant or contract.
Award	Inventor awarded grant or contract. Work commences. Final report due at end of work period.
Complete	Inventor has complied with all the requirements of his Statement of Work, or DOE assistance is terminated. A resume will be inserted in the Recommendation Status Listing summarizing the results.
No Basis For DOE Support	Inventor notified that recommendation will not be supported and given reasons.

Abbreviations for DOE Program Offices as used in the Recommendation Status Listing:

CS	Conservation and Solar Energy
ER	Energy Research
FE	Fossil Energy
ID	Invention Division
RA	Resource Application

FIGURE 1. Support Process Phases

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

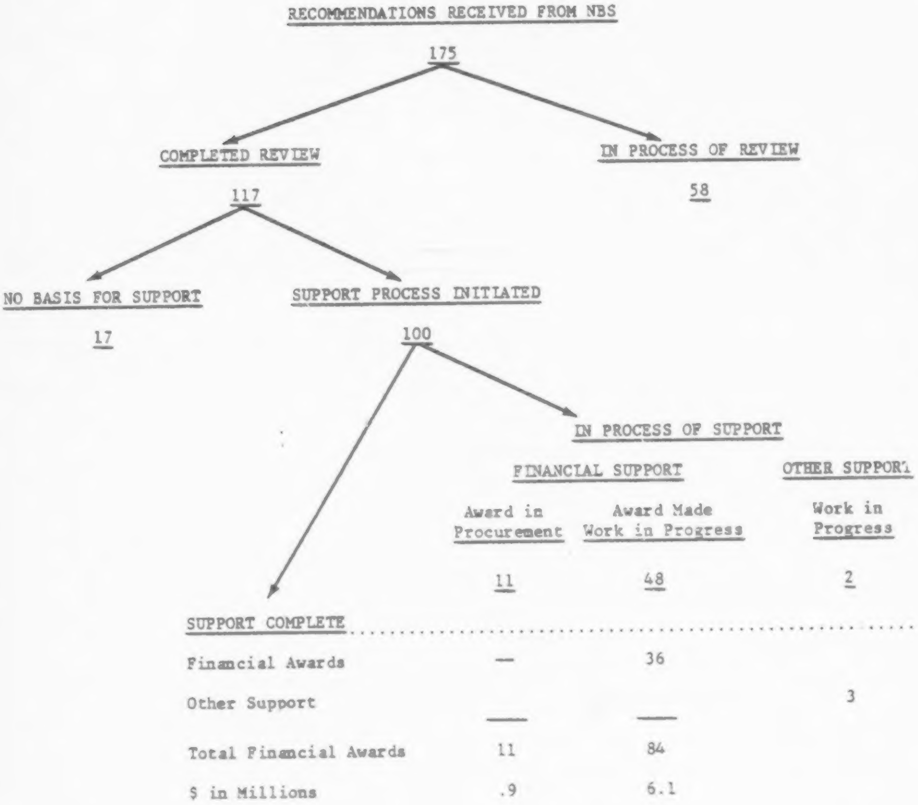
RECOMMENDATIONS RECEIVED FROM NBS
175
COMPLETED REVIEW
117
IN PROCESS OF REVIEW
58
NO BASIS FOR SUPPORT
17
SUPPORT PROCESS INITIATED
100
IN PROCESS OF SUPPORT
FINANCIAL SUPPORT
OTHER SUPPORT
Award in Procurement
Award Made Work in Progress
Work in Progress
11
48
2
SUPPORT COMPLETE
Financial Awards
—
36
Other Support
3
Total Financial Awards
11
84
$ in Millions
.9
6.1

FIGURE 2. Support Statistics as of March 31, 1981

Recommendation Status Listing

Summary pp i-v - Details pp 1-98

DOE Number	Inventor Name	Invention Title	State or Country	Status	Page
1	Willard Graves	Demand Metering System for Electric Energy	MO	No DOE Support	1
2	Rita Paleschuck	Fuel Mixer	NY	Complete	1
3	Donald C Erickson	Hydrogen Generation by Oxidation-Reduction of Tin	MD	Complete	2
4	Joseph C Yater	Power Conversion of Energy Fluctuations	MA	Complete	2
5	George C Austin	Diesel Engine Conversion System	CA	Complete	3
6	Albert B Csonka	Micro-Carburetor	NY	Complete	3
7	Charles Herbert Seaton	Hydraulically Powered Waste Disposal Device	CA	Complete	4
8	Vincent E Carman	Inertial Storage Transmission	OR	Analysis II	4
9	Alvin M Marks	Heat/Electric Power Conversion via Charged Aerosols	NY	Complete	5
10	Harrison Robert Woolworth	Scrap Metal Preheating	WA	Complete	5
11	Ronald H Smith	Solar Collector	CA	Complete	6
12	Frank R Summa	High Frequency Energy Saving Device	NY	Award	6
13	Ranendra K Bose	Anti-Pollution System	VA	Complete	7
14	Daniel J Schneider	Aerodynamic Lift Translator	TX	Complete	7
15	Dante A Raponi	Zetacron	NC	Award	8
16	John W Bruce	Vacuum Drying	SD	Complete	8
17	David W Doyle	Osmotic-Hydro Power Generation	VA	Complete	9
18	G W Fitterer	Control of Low Carbon Aluminum Steels	PA	Complete	9
19	Walter J Hesselman, Jr	Rigid Board Insulation	NY	Award	10
20	Thomas P Hopper	Thermal Shade	CT	Complete	10
21	Robert S Norris	Waste Oil Utilization System	MA	Complete	11
22	Herbert G Lehmann	Fuel Burner Attachment	CT	No DOE Support	11
23	Int'l MGD Companies	Microgas Dispersions	MI	No DOE Support	12
24	Drew W Morris	Can and Bottle Crushing Apparatus	NM	Award	12
25	Donald C Erickson	Sulfur Removal From Producer Gas	MD	Analysis I	13
26	Seymour Jarmul	Compact Energy Reservoir	NY	Complete	13
27	R J Jones	Waste Heat Utilization, Commercial Cooking	CA	Complete	14
28	Gilbert W Didion	Ultraflo	OH	Complete	14
29	Kenneth E Mayo	Tuned Sphere Stable Ocean Platforms	NM	Complete	15
30	Leopold Pessel	Removing Sulfur Dioxide From Flue Gases	PA	Complete	15
31	James C Withers	Ceramic Rotors and Vanes	VA	Award	16
32	Robert A Caughey	Wood Gas Reactor	NH	Award	16
33	Joseph B Vogt	Temperature Indicating Device	WI	Complete	17
34	Mel Ellis	Osmotic Thermogenic Paint	FL	Analysis I	17
35	Gulab Chand Jain	Solar Pond System	India	No DOE Support	18
36	Richard P Gingras	Computerstat	CT	Complete	18
37	Lawrence E Bissell	Hotwater Engine	CA	Analysis I	19
38	John McCallum	Reduction Volatilizations	OH	Complete	19

DOE Number	Inventor Name	Invention Title	State or Country	Status	Page
39	James H Lawler	Lawler Steam Generator	CA	No DOE Support	20
40	Roland P Soule	Blue Water Gas	NY	Decision Phase	20
41	William F Armitage, Jr.	Photovoltaic Device by Solid Phase Growth	WA	No DOE Support	21
42	Everett Killard	Flue Baffle Assembly	IL	Award	21
43	Sidney A Parker	Thermal Gradient Utilization Cycle	TX	Complete	27
44	Leon Lazare	New Working Fluids for Absorption Heat-Pump	CT	Complete	22
45	Joe W Fowler	Bulk Cure Tobacco Barn	NC	Complete	23
46	David J Secunda	Thezon Dehydration	NJ	Complete	22
47	Robert W Arthur	Wastewater Aeration Power Control Device	WI	Award	24
48	Werner E Howald	Howald Combustor	OH	Complete	24
49	Wayne S Beals	Automatic Control System for Water Heaters	CA	No DOE Support	25
50	Robert Cameron	Scotsman Fuel Energizer	IL	Award	25
51	Richard B Bentley	Thermal Efficiency Construction	NY	Analysis II	24
52	Robert G Landry (Deceased)	Air Wedge	NE	No DOE Support	26
53	Harry E Wood	High-Efficiency Water Heater	LA	Complete	27
54	Paul H Schweitzer (Deceased)	Optimizer	PA	Award	27
55	Richard D & Chester Palone	Electrically Heated Sucker-Rod	AR	No DOE Support	28
56	William P Beuler	Flexaflo-The Wet Fuel Dryer	LA	Complete	28
57	Robert H Aicken	K-5 Smoke Eliminator	MN	Award	29
58	Charles M Kirk	A Multiple Spark System Using Inductive Storage	FL	Award	29
59	Bernard Zimmern	Volumetric Gas Turbine	France	Analysis I	[illegible]
60	William H Cone	Electric Transport Refrigerator	IA	Complete	30
61	Willing B Foulke	Fuel Preparation Process	DE	Procurement	31
62	Thaddeus Papis	Tapered Plate Annular Matrix	CA	Award	31
63	Thomas LoGiudice	Fluorobulb	NY	Award	32
64	Shalom Manalla	Manalla Process	AZ	Award	32
65	Lee A Henningsen	Watt Vendor	PA	Award	33
66	Philip Zacuto	Heat Extractor	NY	Award	33
67	James A Browning	Hydraulic Power for Windmills	NH	Award	34
68	Leroy W Bissett	Helical Screw Compressor	VA	Other Assistance	34
69	Enoch J Durbin	Ionic Fuel Control	NJ	Complete	35
70	Kenneth A Stofen	Compressor Heat-Recovery System	WI	Complete	35
71	Arleigh Wangler	Knight Guard	CA	No DOE Support	36
72	Joe Ager	Petro-Plant Waste Gas Boiler	TX	No DOE Support	36
73	Melvin H Sachs	U-Form Technology	MI	Award	37
74	G R Fitterer	Fuel Cell	PA	Complete	
75	Richard Jablin	Coke Quenching	NC	Award	38
76	Donald R Ross	The Ross Furnace	TX	Award	39
77	James e McCord	Variable Heat Refrigeration System	KY	Award	39
78	Robert McNeill	System for High Efficiency Power Generation from Low Temperature Sources	CA	No DOE Support	39
79	Marvin L Wahrman	Oil Well Bit Insert	CA	Complete	40

DOE Number	Inventor Name	Invention Title	State or Country	Status	Page
80	Patsie C Campana	Improved Unfired Refractory Brick	OH	Analysis II	40
81	C Richard Panico	Flash Polymerization	MA	Complete	41
82	Robert L Ullrich	Cool Air Induction	NM	Award	41
83	Charles James Bier	Verticle Solar Louvers	VA	Other Assistance	42
84	Kenneth W Odil	Kinetic Energy Type Pumping System	TX	Analysis II	42
85	Charles J Kalt	Dielectric Windowshade	MA	Analysis I	43
86	Douglas MacGregor	Coke Desulfurization	UT	Complete	43
87	Ruel C Terry	Recovering Uranium From Coal In-Situ	CO	Award	44
88	Alex Rutsheim, et al	System-100	IA	Award	44
89	Henry E Allen	Continuous Casting Process and Apparatus	NY	No DOE Support	45
90	Clinton Van Winkle	Grain Dryer	NE	Analysis I	45
91	James Allen Bagby	Mine Brattice	KY	Award	46
92	John L Carroll	Tri-Water	OR	Analysis I	46
93	Edward H Shelander	Shelander-Burrows Process for Recovery of Metallic Values from Smelter Emissions	GA	Award	47
94	William W FioRito	Lantz Converter	CA	Analysis II	47
95	Val O Bertola	Omni-Horizontal Axis-Wind Turbine	PA	No DOE Support	48
96	Floyd R Anderson	Leavell, Pneumatic Precussion Tools and Systems	AR	Complete	48
97	James W McCord	Water Drying System	KY	Award	49
98	James L Chill	Process Development to Conserve Energy and Material Bearings	OH	Award	49
99	Oscar Weingart	Light Weight Composite Trailer Tubes	CA	Award	50
100	Michael F Zinn	Solaroll	NY	Award	50
101	Sharad M Dave	Controlled Combustion Engine	MI	Procurement	51
102	Frank C Bernhard	Method of Burning Residual Fuel Oil in Distillate Fuel Oil Burners	MO	Award	51
103	Edwin E Eckberg	Low Voltage Ionic Fluorescent Light Bulb	ID	Award	52
104	Eskil L Karlson	Low Continuous Energy Mass Separation System	PA	Award	52
105	Allen D Zumbrunnen	High Frequency Furnace	UT	Analysis II	53
106	James L Ramer	Deep Shaft Hydro-Electric Power	WI	No DOE Support	53
107	Ping-Wha Lin	Waste Products Reclamation Process	NY	Analysis I	54
108	Paul J Cromwell	Processing Recovery of Aluminum	NY	Award	54
109	H. W. Kennick	Hydrostatic Meat Tenderizer	OR	Award	55
110	Karl H. Bergey	Improved Windpower Generating System	OK	Award	55
111	John C Hespert	Hespert Mining System	CA	Award	56
112	Paul Zenoni	Pump	WA	Decision Phase	56
113	Henry J Wallace	Wallace Weld Additive System	PA	No DOE Support	57
114	Renato Menzini	New Energy-Saving Tire for Motor Vehicles	Milan, I	Analysis I	57
115	Clyde G Phillips	Refrigeration System	DE	Complete	58
116	Roy J Weikert	Model 5000 ASEPAK System	OH	No DOE Support	58
117	John Mattson	"Solarspan" Prism Trap	MA	Award	59
118	Roderick L Smith	Energy Adaptive Control of Precision Grinding	IL	Decision Phase	59

DOE Number	Inventor Name	Invention Title	State or Country	Status	Page
119	Elden L Asher	Air Ratio Controller (AERTROL)	FL	Procurement	60
120	Robert Zartarian	Vapor Heat Transfer Commercial Griddle	MA	Decision Phase	60
121	James B Whitmore	Solar Space Heating for both Retrofit and New Construction	MI	Analysis II	61
122	Michael D Lechner	Lean Limit Controller	NJ	Award	61
123	J Paul Pemsler	Comminution of Ores by a Low-Energy Process	MA	Award	[illegible]
124	Charlton Sadler	Solar Collector	FL	Analysis II	62
125	Frank W Bailey	The Turbulator Burner-System	NJ	Award	63
126	Karl D Scheffer	Vaclaim	NY	Award	63
127	J D Seader	Process and Apparatus to Produce Crude Oil from Tar Sands	UT	Analysis I	64
128	J D Seader	Continuous Distillation Apparatus and Method	UT	Analysis I	64
129	James E Kessler	Super U System - Snap Strap	KS	Award	64
130	Arnold R Post	Furnace Input Capacity Trimming Switch	PA	Analysis I	65
131	Edgar R Jordan	Valve Deactuator for Internal Combustion Engines	MI	Award	66
132	Michael Knezevich	Process for Reclaiming and Upgrading Thin-Walled Malleable Waste Material	IN	Analysis I	66
133	P J Parhats	AUTOTHERM Car Comfort System	IL	Procurement	67
134	John C Rupert	Expanded Polystyrene Bead Insulation System	MN	Award	67
135	M Hossein Khorsand	Point Focus Parabolic Solar Collector	ID	Decision Phase	6[illegible]
136	Albert S Richardson, Jr.	Windamper	MA	Decision Phase	68
137	H Roy Weber	A Portable Pollution Free Automobile Incinerator	HI	Procurement	69
138	Gerald R Seaman	Phantom Tube	CA	Analysis II	6[illegible]
139	Louis L Merton	Transformer with Heat Dissipater	CA	Analysis II	70
140	W E Mattson	Counter Flow Dual Tube Heat Exchanger	MN	Analysis II	70
141	Samuel Shiber	New Hydrostatic Transmission	IL	Analysis II	71
142	Anatol Michelson	Process for Heatless Production of Hollow Items	FL	Procurement	71
143	Robert A Clay	Oil Well Pump Jack	CA	Analysis II	72
144	Robert C Saunders, Jr.	SpaCirc Space Circulation Fan	MO	Decision Phase	72
145	Robert E Salomon	Solar Conversion by Concentration Cells with Hydrides	PA	Procurement	73
146	Sylvain J Pirson	Line Integral Method of Magneto-Electric Exploration	TX	Analysis II	73
147	Henry Koop, Jr.	Railroad Switch Heater	CT	Analysis II	74
148	Leonard A Duval	Reclamation of Oil and High-Grade Iron Concentrates from Steel Mill Wastes	OH	Analysis II	
149	Ogden H Hammond	SCOTCH - (Simple, Cost-Effective, Optimum Temperature Control for Housing)	MA	Award	75
150	Edward W Widlam	Utilization of Oil Waste in the Manufacture of Portland Cement	LA	Decision Phase	75

DOE Number	Inventor Name	Invention Title	State or Country	Status	Page
151	Yee Tsu Li	Film Type Storm Window	WA	Decision Phase	76
152	David S Majerzak	Vehicle Exhaust Gas Warm-up System	MD	Decision Phase	76
153	Carl E Pearl	A New Equipment Design Concept for Storage of Hot Foods	CA	Analysis I	77
154	Forrest E Chancellor	Rotating Horsehead for Pumping Units	CA	Decision Phase	77
155	James M Cleary	Slip Mining	KS	Analysis II	78
156	James J Dolan	Direct-Current Electrical Heat-Treatment.	CT	Analysis II	78
157	Albert L McQuillen, Jr	Magnaseal Method and Means for Sealing Steel Ingot Casting Molds to Stools.	PA	Procurement	79
158	Paul F Pugh	Energy Conservative Electric Cable System	CA	Analysis II	79
159	William D Gramling	Non-Tubing Type Gas Powered Lift Device	MO	Decision Phase	80
160	Leon Lazare	High Efficiency Absorption Refrigeration Cycle	CT	Procurement	80
161	Anthony A duPont	duPont Connell Energy Coal Gasification Process	CA	Analysis II	81
162	Lemuel Leslie Ply	Tubular Pneumatic Conveyor Pipeline	TX	Analysis I	81
163	Dennis D Howard	Thermotropic Plastic Films	PA	Procurement	82
164	Robert R Larsen	Elastomer Energy Recovery Elements	MO	Procurement	82
165	Wu-Chi Chen	Process for Recovering Hydrogen	TX	Analysis I	83
166	Robert F Evans	Borehole Angle Control	TX	Analysis II	83
167	Edward B Connors	Vaned Pipe for Pipeline Transport of Solids	ID	Analysis II	84
168	Spencer Kim Haws	The Hot Water Saver	WA	Analysis II	84
169	Marvin W Martin	MIRAFOUNT	MO	Analysis I	85
170	Thomas R Wee	Fog System - Low Energy Freeze Protection for Agriculture	CA	Analysis I	85
171	Karekian Bedrosian	A Method of Preserving Fruits and Vegetables without Refrigeration	NJ	Decision Phase	86
172	Edward A Griswold	GEM Electrostatic Filtration System	CA	Analysis I	86
173	Bil. Burley	Thermal Ice Cap	PA	Analysis I	87
174	E C Nathaniel	Skate on Plastic Ice Skating System	MO	Analysis I	87
175	Don W Acree	A Low-Energy Carpet Backing System	GA	Analysis I	88

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 1 DOE Coordinator G. K. Ellis Contact: Murray G Lowenthal

OERI # 19 DOE Program Off: CS

Category: Miscellaneous

Title: Demand Metering System for Electric Energy

Inventor: Willard Graves
State/Country: MD
Company: Environmentrics, Inc.

Patent # 3 683 343

Description: The invention provides a means whereby a consumer's electric meter can be adjusted by the electric company to run at a faster rate at times of greater loads upon the utility system -- load leveling.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 23, 1975 Decision Date:

Received by DOE from NBS: Feb 12, 1976 Final Report Accepted: Jul 7, 1977

Status: No DOE Support

Development Stage:

Summary: No area of appropriate DOE support could be identified.

DOE # 2 DOE Coordinator G. K. Ellis Contact: Rita Poleschuck

OERI # 100 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Fuel Miser

Inventor: Rita Poleschuck
State/Country: NY
Company: Flair Mfg. Corp.

Description: The device is an attachment which can be used to retrofit a room thermostat with a synchronous motor-driven clock timer and an auxiliary heating element to enable it to have a temperature set-back cycle.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 14, 1975 Completion Date: Jul 15, 1976

Received by DOE from NBS: Feb 19, 1976 Final Report Accepted:

Status: Complete

Development Stage: Production & Marketing

Summary: No research and development required, since the device is on the market. A generic brochure was written and published on the "need for automatic temperature setback." Extensive distribution was accomplished through DOE's Office of Public Affair's "supermarket handout" program and General Services Administration's Consumer Information Center.

DOE # 3 DOE Coordinator D.R.Craig

OERI # 3 DOE Program Off: FE

Category: Other Natural Sources

Title: Hydrogen Generation from Producer Gas by
Oxidation-Reduction of Tin

Contact: Donald C Erickson
Director of Research
Energy Concepts Co.
1704 South Harbor Lane
Annapolis MD 21401
301/268-4521

Inventor: Donald C Erickson
State/Country: MD
Company: Energy Concepts Co.

Patent Applied For

Description: Patent applied for. A new approach to the generation of tonnage hydrogen from carbonaceous fuels. Two reactions: steam with tin, whereby hydrogen is produced, and the reduction of the tin oxide produced in the first reaction back to tin.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 7, 1975 Completion Date: Jul 12, 1978

Received by DOE from NBS: May 21, 1976 Final Report Accepted: Feb 13, 1981

Status: Complete Award Amount: $80,820

Development Stage: Laboratory Test

Summary: $80,820 grant, for the grantee to conduct a research program, including laboratory investigation to better identify the optimum operating conditions, modeling and analysis to better identify the achievable efficiencies and economics, plus identification and probing of any potential problems.

DOE # 4 DOE Coordinator G.K.Ellis

OERI # 230 DOE Program Off: ER

Category: Direct Solar

Title: Power Conversion of Energy Fluctuations

Contact: Joseph C Yater
Autumn Lane
Lincoln MA 01773
617/259-8544

Inventor: Joseph C Yater
State/Country: MA
Company:

Patent Applied For

Description: A solid state device is claimed that can transfer thermal energy into usable electrical power with high efficiency, by cascading large numbers of such circuits.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 18, 1975 Completion Date: Dec 2, 1976

Received by DOE from NBS: Jun 4, 1976 Final Report Accepted: Jun 15, 1977

Status: Complete Award Amount: $40,400

Development Stage: Concept Development

Summary: A $40,400 contract was granted to define an adequate development plan. Final report has been received and reviewed. Letter to inventor advised him of DOE decision not to support further work, as the review has indicated the scheme to be impractical. An updated version in a proposal submitted by Mr. Yater is currently being reviewed by DOE.

DOE # 5 DOE Coordinator G. K. Ellis

OERI # 88 DOE Program Off: CS

Category: Combustion Engines & Components

Contact: George C Austin
Austin Tool Company
2239 North Loma Ave.
South El Monte CA 91605
213/442-7238

Title: Diesel Engine Conversion System for Gasoline Engines

Inventor: George C Austin
State/Country: CA
Company: Austin Tool Co.

Description: The system is proposed for converting a standard gasoline auto engine into a diesel engine

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 30, 1975 Completion Date: Jun 19, 1978

Received by DOE from NBS: Aug 12, 1976 Final Report Accepted: Nov 20, 1978

Status: Complete Award Amount: $18,000

Development Stage: Engineering Design

Summary: An $18,000 grant for a marketing study was awarded, and completed. Significant interest by those surveyed was expressed in the Austin diesel conversion, if they were having their engine rebuilt. However, more vehicles would need to be tested, in order to offer substantive proof of reliability.

DOE # 6 DOE Coordinator D. G. Wells

OERI # 225 DOE Program Off: CS

Category: Combustion Engines & Components

Contact: Albert B Csenka
FERRO Technical Co.
109 Larchmont Road
Buffalo NY 14214
716/837-3122

Title: Micro-Carburetor

Inventor: Albert B Csenka
State/Country: NY
Company: FERRO Technical Company

Patent Applied For

Description: A new kind of carburetor which is claimed to be fuel-saving and pollution-reducing.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 15, 1975 Completion Date: Sep 2, 1977

Received by DOE from NBS: Aug 17, 1976 Final Report Accepted: Feb 13, 1980

Status: Complete Award Amount: $193,500

Development Stage: Engineering Design

Summary: A $193,500 fixed price development contract to build a working micro-carburetor, sized to fit a late model, standard 350 cubic inch V-8 engine. Contract is being administered by Office of Transportation Programs, DOE.

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              Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report
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                                                          Contact: Charles Herbert Seaton
    DOE #        7      DOE Coordinator  G. K. Ellis               Westemate Corporation
                                                                   4830 Viewridge Avenue
    OERI #     387      DOE Program Off: CS                        San Diego            CA  92123
                                                                   714/292-8181
    Category: Miscellaneous

    Title: Hydraulically Powered Waste Disposal Device

                                                                   Patent # 3 700 178

    Inventor:  Charles Herbert Seaton
    State/Country:  CA
    Company:   Westemate Corporation

    Description:  The device is to replace conventional food waste disposal units which are
                  powered by electric motors.



    Significant Dates, Status and  Summary of Developments:

      Form 1019 Rec'd by NBS:     Nov 10, 1975      Completion Date:          May 22, 1975

      Received by DOE from NBS:   Aug 28, 1976      Final Report Accepted:    Aug 29, 1979

                                                 Award Amount:   $25,000
      Status:  Complete

      Development Stage: Production Engineering

    Summary:        A $25,000 grant was awarded and completed for the grantee to contract with a
                    qualified management consulting firm to assist them in preparing a business
                    and financial plan. The plan is intended to assist the grantee in acquiring
                    the necessary capital funding to get their residential-sized water-powered
                    food waste-disposer unit into full production. The grantee is negotiating with
                    several funding sources, and indicates hope of early success.
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                                                          Contact: Eugene Lucas
    DOE #        9      DOE Coordinator  [illegible]

    OERI #     423      DOE Program Off: CS

    Category: Transportation Systems, Vehicles & Components

    Title: Inertial Storage Transmission

                                                                   Patent # 3 903 696

    Inventor:  Vincent E Carman
    State/Country:  OR
    Company:   Advanced Energy Systems

    Description:  The device is a system for improving the efficiency and reducing the fuel
                  consumption of a motor vehicle, utilizing a regenerative hydraulic system to
                  store the kinetic energy from deceleration for use in accelerating the
                  vehicle.


    Significant Dates, Status and  Summary of Developments:

      Form 1019 Rec'd by NBS:     Nov 12, 1975      Decision Date:

      Received by DOE from NBS:   Sep  3, 1976      Final Report Accepted:

      Status:  Analysis II

      Development Stage: Concept Development

    Summary:        Technical Assistance terminated 12-79. Inventor has been unable to deliver a
                    test vehicle, to begin testing according to a mutually agreed schedule. DOE
                    reconsidering support to a successor company which plans to market the device.
                    Proposal not yet submitted.

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                                                                                  Page:   6
    Date:  Mar 31, 1981
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DOE # 9 DOE Coordinator D. G. Malle

OERI # 151 DOE Program Off: ER

Category: Miscellaneous

Contact: Alvin M Marks
Marks Polarized Corp.
153-16 Tenth Avenue
Whitestone NY 11357
212/767-0600

Title: Heat/Electric Power Conversion via Charged Aerosols

Inventor: Alvin M Marks
State/Country: NY
Company: Marks Polarized Corporation

Patent Applied For

Description: This device is to convert thermal energy to electric energy without the use of moving parts.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 4, 1976 Completion Date: Feb 27, 1978

Received by DOE from NBS: Sep 13, 1976 Final Report Accepted: May 9, 1979

Status: Complete Award Amount: $50,000

Development Stage: Laboratory Test

Summary: A grant in the amount of $50,000 was awarded to construct and test an Electro Gas Dynamics Generator, and then use this device to investigate the condensation charging of a steam jet. This project is being followed by a three year program to build and test a 10kw laboratory model of the device. First year approved funding is $199,677. Starting date: September 1, 1979.

DOE # 10 DOE Coordinator G. K. Ellis

OERI # 421 DOE Program Off: CS

Category: Industrial Processes

Contact: Harrison Robert Woolworth
International Preheater
P.O. Box #88216
Tukwila Branch
Seattle WA 98188
206/552-9040

Title: Scrap Metal Preheating Method and Apparatus

Inventor: Harrison Robert Woolworth
State/Country: WA
Company: International Preheater

Description: The device provides a means of extracting waste heat from hot ingots and billets and utilizing this waste heat to preheat scrap steel prior to placing it in an electric-arc furnace.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 11, 1975 Completion Date: Dec 23, 1977

Received by DOE from NBS: Sep 29, 1976 Final Report Accepted: Oct 23, 1979

Status: Complete Award Amount: $170,000

Development Stage: Production Engineering

Summary: A grant in the amount of $170,000 was awarded to design and fabricate hardware, and to operate a system, utilizing waste heat for preheating scrap steel, in a working specialty steel mill. A 20% or more energy saving was demonstrated. Steel company interest has developed, and the inventor has obtained SBA loan assistance to get into production.

DOE # 11 DOE Coordinator: D. G. Mello
OERI # 233 DOE Program Off: CS

Contact: Ronald H Smith
150 Green Street
San Francisco CA 94111
415/398-6813

Category: Direct Solar

Title: Solar Collector

Inventor: Ronald H Smith
State/Country: CA
Company: Solergy, Inc.

Description: This is a composite extruded aluminum section -- incorporating a cylindrical absorption tube that carries the working fluid. The collector surface is in the form of an Archimedes Spiral and a parabolic curve to maximize the collection angle and eliminate the need to reposition the collector.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 9, 1975 Completion Date: May 17, 1978

Received by DOE from NBS: Sep 29, 1976 Final Report Accepted: Nov 19, 1980

Status: Complete Award Amount: $40,884

Development Stage: Production Engineering

Summary: A grant in the amount of $40,884 has been awarded to Solergy, Inc., which will initiate a series of marketing studies to determine the attitudes of Western U.S. manufacturers, distributors, designers, regarding prospects for successful installation of passive solar systems in new buildings. Survey results will be used by Solergy to aid their marketing and manufacturing plans, and will also be useful to DOE.

DOE # 12 DOE Coordinator: J. Aellen
OERI # 448 DOE Program Off: CS

Contact: Thomas J Russo
100 Forest Avenue
Staten Island NY 10310
212/273-0248

Category: Buildings, Structures & Components

Title: High Frequency Energy Saving Device

Inventor: Frank R Summa
State/Country: NY
Company: Electridex Corp.

Patent Applied For

Description: This invention consists of a high-frequency generator, to excite one of several fluorescent lights, replacing the normal ballast transformer, and allowing the system to operate at substantially higher efficiency.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 28, 1975 Award Date: Sep 29, 1979

Received by DOE from NBS: Sep 30, 1976 Final Report Accepted:

Status: Award Award Amount: $30,000

Development Stage: Engineering Design

Summary: A Grant in the amount of $30,000 has been awarded to engage the services of Nicol-Fitzmaurice and Associates, Inc., to conduct a marketing study and prepare a preliminary business plan for the purpose of commercializing the technology.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 13 DOE Coordinator D. G. Mello
OERI # 53 DOE Program Off: CS

Contact: Ranendra K Bose
1554 North Danville Street
Arlington VA 22201
703/524-6209

Category: Transportation Systems, Vehicles & Components

Title: Anti-Pollution System

Inventor: Ranendra K Bose
State/Country: VA
Company:

Patent # 3 861 142

Description: This device utilizes a high speed turbine to refine exhaust gases and recirculates the unburned portions of that gas to the engine.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 3, 1975 Completion Date: Apr 4, 1979

Received by DOE from NBS: Sep 30, 1976 Final Report Accepted: Jan 3, 1979

Status: Complete Award Amount: $40,000

Development Stage: Limited Production/Marketing

Summary: A Grant in the amount of $40,000 was awarded. A Prototype was built and tested. Project goals were met. Final Report was accepted. Device works. Inventor plans to seek private assistance for commercialization.

DOE # 14 DOE Coordinator D. G. Mello
OERI # 146 DOE Program Off: CS

Contact: Daniel J Schneider
608 Durango Circle, South
Irving TX 75062
214/252-6338

Category: Other Natural Sources

Title: Aerodynamic Lift Translator

Inventor: Daniel J Schneider
State/Country: TX
Company:

Description: This device is a wind-activated power generating system intended to provide large power outputs in regions where the prevailing wind direction does not vary appreciably during the year.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 18, 1975 Completion Date: Sep 21, 1977

Received by DOE from NBS: Sep 30, 1976 Final Report Accepted: Jan 11, 1979

Status: Complete Award Amount: $50,000

Development Stage: Production Engineering

Summary: $50K grant to develop performance and cost data for the "Schneider Aerodynamic Power Generator" and compare these data with conventional propeller rotor windmills. Final report has been received and accepted.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 18 DOE Coordinator R.Bell

OERI # 393 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Estacron

Contact: James L Bullock
Suite #403, Minges Building
P. O. Box #7151
Greenville NC 27834
919/752-1138

Inventor: Dante A Reponi
State/Country: NC
Company: Estacron International, Inc.

Patent Applied For

Description: Estacron consists of an aggregate of Portland cement, fly ash, stack dust, and polyethylene. It has significant potential as a light-weight and energy-conservative construction material.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 28, 1975 Award Date: Jul 28, 1979

Received by DOE from NBS: Sep 30, 1976 Final Report Accepted:

Status: Award Award Amount: $101,388

Development Stage: Laboratory Test

Summary: A Grant in the amount of $101,388 has been awarded to conduct an application engineering and economic analysis of the material, Estacron, in order to assess its material characteristics and to recommend product applications.

DOE # 16 DOE Coordinator G. K. Ellis

OERI # 486 DOE Program Off: CS

Category: Industrial Processes

Title: Method and Apparatus for Vacuum Drying of Commodities

Contact: John W Bruce
West Highway, #16
Mitchell SD 57301
605/996-8335

Inventor: John W Bruce
State/Country: SD
Company:

Patent # 3 914 874

Description: This invention describes a new method of drying commodities, primarily applicable to such grains as corn, rice, and soybeans, by alternately exposing the commodities to dry heated air and to a vacuum.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 16, 1975 Completion Date: Feb 22, 1978

Received by DOE from NBS: Nov 30, 1976 Final Report Accepted: Mar 30, 1981

Status: Complete Award Amount: $52,917

Development Stage: Engineering Design

Summary: A grant in the amount of $52,917 has been awarded to design, fabricate, and demonstrate a device for efficiently drying agriculture commodities. The Montana Energy and MHD Development Institute is managing the technical aspects of the program.

DOE # 17 DOE Coordinator D. G. Wells
OERI # 419 DOE Program Off: CS

Contact: David W. Doyle, V.P.
Intertechnology Corp.
100 Main Street
Warrenton VA 22186

Category: Other Natural Sources

Title: Osmotic-Hydro Power Generation

Inventor: David W Doyle
State/Country: VA
Company: InterTechnology Corp.

Patent Applied For

Description: The invention uses a reverse osmosis to produce high pressure liquid that can subsequently be passed through a hydraulic turbine to produce electric power.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 21, 1976 Completion Date: Aug 11, 1977

Received by DOE from NBS: Jan 10, 1977 Final Report Accepted: May 1, 1978

Status: Complete Award Amount: $48,950

Development Stage: Laboratory Test

Summary: $48,950 was granted for research and development of membranes suitable for us in a "Osmo-Hydro Power" system. Studies include: membrane long-term effects, polarization dilution, and concentration. The research was judged as high quality, by the DOE cognizant program office.

DOE # 18 DOE Coordinator G. K. Ellis
OERI # 177 DOE Program Off: CS

Contact: G R Fitterer
P.O. Box #206
Oakmont PA 15139

Category: Industrial Processes

Title: The Control of the Analysis of Low Carbon Aluminum Steels Using Oxygen Sensors and Iron-Aluminum Alloy

Inventor: G R Fitterer
State/Country: PA
Company: Fitterer Engineering Assoc., Inc.

Patent # 3 773 641 & Others

Description: The production of Al "killed" steel is intended to be controlled by the use of Fe-Al alloys instead of Al and by the use of oxygen probes to control the amounts of Al or oxygen in the melt.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 1, 1975 Completion Date: Aug 11, 1977

Received by DOE from NBS: Jan 31, 1977 Final Report Accepted: Sep 14, 1978

Status: Complete Award Amount: $99,000

Development Stage: Production & Marketing

Summary: A grant in the amount of $99,000 was awarded for a system to conserve energy by monitoring and controlling the amount of oxygen in a low carbon aluminum killed steel melt. The system was highly successful. On basis of the success, the steel company involved has initiated a research effort to apply the technology to other ferro melts.

DOE # 19 DOE Coordinator D.R.Craig Contact: Clair M Reinbergen, Pres.
C. P. Chemical Co., Inc.
OERI # 205 DOE Program Off: CS 25 Home Street
White Plains NY 10606
Category: Buildings, Structures & Components 914/428-2517

Title: Phenol Methelol Foam Rigid Board Insulation

Inventor: Walter J Hesselmen, Jr Patent Applied For
State/Country: NY
Company: C. P. Chemical Co., Inc.

Description: This invention is a urea-formaldehyde phenol methelol modified form insulating board material. Properties are similar to others on the market except for its fire retardancy and the low toxicity of its combustion products.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 18, 1975 Award Date: Sep 13, 1978

Received by DOE from NBS: Feb 4, 1977 Final Report Accepted:

Status: Award Award Amount: $29,900

Development Stage: Production Engineering

Summary: $29,900 one year grant to study physical properties of proprietary insulating material, and to determine the optimum ratios of base chemicals. The result will be a product which maximizes insulating properties while minimizing costs, thereby assuring cost effectiveness in the market.

DOE # 20 DOE Coordinator D. G. Wells Contact: Thomas P Hopper
RFD #1, Box #689
OERI # 839 DOE Program Off: CS Durham CT 06422
203/453-6801
Category: Buildings, Structures & Components

Title: Thermal Shade

Inventor: Thomas P Hopper Patent Applied For
State/Country: CT
Company: Insulating Shade Co.

Description: The device is a multi-layer window shade to be fitter to conventional windows and to retract into a small space — uses reflective surface coatings and with dead air spaces between the layers to reduce heat transfer.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 26, 1976 Completion Date: Jun 1, 1979

Received by DOE from NBS: Feb 28, 1977 Final Report Accepted: Jan 8, 1979

Status: Complete Award Amount: $50,707

Development Stage: Production Engineering

Summary: A grant in the amount of $50,707 was awarded for the investigations and research of sheet material, seal configurations, and assemblies with third party testing. In addition, marketing assistance was supplied by MIT Innovation Center. Product is now being market tested.

DOE # 21 DOE Coordinator G. K. Ellis

OERI # 613 DOE Program Off: CS

Category: Industrial Processes

Title: Waste Oil Utilization System

Contact: Robert S Morris
Energy Conservation Systems
10 Starboard Way - Box #472
West Dennis MA 02670
617/398-3430

Inventor: Robert S Morris
State/Country: MA
Company: Energy Conservation Systems

Patent # 3 002 826 & Others

Description: This invention would utilize existing emulsification machinery to add a mixture of used lubricating oil and water to fuel oil used in large power plant boilers. Key point is the use of existing additives in fuel oil to prevent boiler tube deposits.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 25, 1975 Completion Date: May 17, 1978

Received by DOE from NBS: Feb 28, 1977 Final Report Accepted: Mar 30, 1981

Status: Complete Award Amount: $50,000

Development Stage: Production & Marketing

Summary: A grant of $50,000 was awarded for the purpose of undertaking a market survey for the use of waste automotive crankcase lubricating oil as a fuel additive to prevent boiler tube deposits, augment energy availability, and minimize environmental pollution.

DOE # 22 DOE Coordinator J. G. Mello

Contact: Herbert G Lehmann

OERI # 537 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Fuel Burner Attachment

Inventor: Herbert G Lehmann
State/Country: CT
Company:

Description: Device to reduce oil consumption by introducing air to oil stream of the burner.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 29, 1975 Decision Date:

Received by DOE from NBS: Feb 28, 1977 Final Report Accepted: Sep 19, 1977

Status: No DOE Support

Development Stage: Laboratory Test

Summary: The inventor had his device tested without DOE funding by a private contractor and advised DOE by telephone on September 19 that these tests demonstrated his device to be unsuccessful and that he is withdrawing his device from DOE consideration.

DOE # 23 DOE Coordinator D. G. Mello Contact: James E Luber

OERI # 951 DOE Program Off: CS

Category: Other Natural Sources

Title: Microgas Dispersions

Inventor: Int'l MGD Companies Patent # 3 900 420
State/Country: MI
Company: Int'l MGD Co.

Description: Device consists of a motor, pump, bubble machine, and valves, uses #2 fuel oil, compressed air, surfactant, to maintain bubbles. Resulting mixture burns like natural gas, which burner can use interchangeably, thereby allowing industrial burners to switch fuels. Can also use small amounts of coal dust in the mixture.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 22, 1975 Decision Date:

Received by DOE from NBS: Mar 28, 1977 Final Report Accepted: Oct 24, 1978

Status: No DOE Support

Development Stage: Laboratory Test

Summary: Brookhaven National Laboratory agreed to test the burner but advised OSP on June 17, 1977, that they were unable to contact the inventor. An attorney representing the company stated in a letter dated November 10, 1977, that he wished to delay all actions until January 1978 pending resolution of patent related negotiations. On October 24, 1978, OSP advised inventor that support was terminated due to lack of response to repeated inquiries.

DOE # 24 DOE Coordinator G. K. Ellis Contact: Drew W Morris
P.O. Box #515
Hampton NH 03842
603/926-4703

OERI # 819 DOE Program Off: CS

Category: Industrial Processes

Title: Can and Bottle Crushing Apparatus

Inventor: Drew W Morris Patent Applied For
State/Country: NH
Company: Drew-It-Corp.

Description: The invention consists of a portable trailer-mounted device for crushing cans and bottles thereby increasing the density of the scrap, making handling more efficient.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 22, 1976 Award Date: Sep 14, 1977

Received by DOE from NBS: Mar 30, 1977 Final Report Accepted:

Status: Award Award Amount: $35,000

Development Stage: Production Engineering

Summary: A grant in the amount of $35,000 was awarded to construct and operate five mobile can-and-bottle crushers, and assemble data on the machine's efficiency and reliability.

DOE # 25 DOE Coordinator D.R.Craig Contact: Donald C Erickson

OERI # 2 DOE Program Off: FE

Category: Industrial Processes

Title: Sulfur Removal from Producer Gas-High Temperature

Inventor: Donald C Erickson
State/Country: MD
Company: Energy Concepts Company

Description: The concept envisions the removal of hydrogen sulfide from a high temperature "producing gas" stream using two scrubbing stages in series, a molten carbonate salt bath and a molten copper bath, each complete with a continuous regeneration cycle.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 7, 1975 Decision Date:

Received by DOE from NBS: Apr 6, 1977 Final Report Accepted:

Status: Analysis I

Development Stage: Laboratory Test

Summary: Negotiations for a grant on this invention are awaiting completion of work done on a previous grant from the DOE.

DOE # 26 DOE Coordinator D. G. Mello Contact: Seymour Jarmul
3000 Marcus Avenue
Lake Success NY 11040
516/488-1444

OERI # 782 DOE Program Off: CS

Category: Miscellaneous

Title: Compact Energy Reservoir

Inventor: Seymour Jarmul
State/Country: NY
Company:

Description: A room-heating convector which stores energy in eutectic salts and radiates the heat to the room under thermostatic control.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 17, 1975 Completion Date: Aug 2, 1978

Received by DOE from NBS: Apr 12, 1977 Final Report Accepted: Oct 26, 1979

Status: Complete Award Amount: $20,740

Development Stage: Prototype Test

Summary: A grant in the amount of $20,740 was awarded for a 9 month project. Inventor designed, constructed and functionally tested a prototype CER suitable for heating a 375 sq.ft. room in a well-insulated house similar to Solar One at the University of Delaware. DOE decided it was not necessary to subsequently subject the device to quantitative tests. A Qualitative assessment was given to the inventor for his consideration. Inventor, who need not participate in this testing phase.

DOE # 27 DOE Coordinator D. G. Mello

OERI # 1208 DOE Program Off: CS

Contact: R J Jones
2772 Salmon Drive
Los Alamitos CA 90720
213/430-3211

Category: Buildings, Structures & Components

Title: Waste Heat Utilization for Commercial Cooking Equipment

Inventor: R J Jones
State/Country: CA
Company: Hydrocell Corporation, Inc.

Patent # 4 084 748

Description: Waste heat utilization for commercial cooking equipment to recover some of the energy in such a way as to avoid interaction with grease vapors.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 13, 1976 Completion Date: Feb 1, 1978

Received by DOE from NBS: Apr 14, 1977 Final Report Accepted:

Status: Complete Award Amount: $65,000

Development Stage: Limited Production/Marketing

Summary: A grant for a 9 month project, in the amount of $65,000 was awarded. Inventor fabricated two production-ready Hydrocells: one for water, one for air. Calspan Corporation conducted a series of tests. Research facility of American Gas Association evaluated and provided a comprehensive engineering report. results of Fall '78 AGA tests proved that unit operates as expected. Inventor now commercializing product.

DOE # 28 DOE Coordinator D. G. Mello

OERI # 101 DOE Program Off: CS

Contact: Gilbert W Didion

Category: Buildings, Structures & Components

Title: Ultraflo

Inventor: Gilbert W Didion
State/Country: OH
Company: Ultraflo Corporation

Patent # 3 668 884

Description: Ultraflo, a hot water energy-saving system for buildings, is a water delivery system controlling temperature and flow by switches, low voltage current, and solenoid valves.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 30, 1975 Completion Date: Aug 1, 1977

Received by DOE from NBS: Apr 27, 1977 Final Report Accepted: Oct 24, 1979

Status: Complete ✓

Development Stage: Limited Production/Marketing

Summary: The invention was tested in California under program auspices. The program has agreed to give marketing assistance by publicizing the results of these tests. At the program's invitation the company has participated in a marketing project in Denver during August 1977.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 29 DOE Coordinator D. G. Wells

OERI # 800 DOE Program Off: CS

Contact: Kenneth E Mayo
Tuned Sphere Intl., Inc
111 Lock Street
Nashua NH 03060

Category: Fossil Fuels

Title: Tuned Sphere Stable Ocean Platforms

Inventor: Kenneth E Mayo
State/Country: NH
Company: Tuned Sphere International, Inc.

Patent # 3 837 308 & Others

Description: This invention presents a unique design approach for an ocean platform, by which the body's natural tendency to roll with wave excitation is diminished or offset.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 19, 1975

Completion Date: Sep 30, 1977

Received by DOE from NBS: May 10, 1977

Final Report Accepted: Feb 6, 1979

Status: Complete

Award Amount: $90,000

Development Stage: Prototype Test

Summary: An award in the amount of $90,000 was granted for a nine (9) month study program to test vessel models, list pertinent parametric data, produce motion picture evidence of vessel stability, and provide reduced graphical data. Completion date was extended to August 1978, at no cost to allow for extension of tank tests and subsequent data reduction. Final report has been received and accepted as meeting all the requirements of the grant.

DOE # 39 DOE Coordinator G. K. Ellis

OERI # 482 DOE Program Off: FE

Contact: Leopold Pessel
AEL-ENTEC Corp.
P.O. Box #507
Lansdale PA 19446
215/368-2440

Category: Industrial Processes

Title: Method of Removing Sulfur Dioxide from Flue Gases

Inventor: Leopold Pessel
State/Country: PA
Company: AEL-ENTEC Corp.

Patent Applied For

Description: Embodies the scrubbing of flue gases with an aqueous solution of metal salt.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 8, 1975

Completion Date: Jun 19, 1978

Received by DOE from NBS: May 17, 1977

Final Report Accepted: Feb 7, 1980

Status: Complete

Award Amount: $94,150

Development Stage: Laboratory Test

Summary: A grant in the amount of $94,150 was awarded to 1) conduct a laboratory-scale testing program to further clarify the basic chemical reactions of the process in controlled but realistic environments, and 2) to provide background material for an economic analysis of the process. The results appear promising.

Date: Mar 31, 1981

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DOE # 31 DOE Coordinator G. K. Ellis

OERI # 278 DOE Program Off: CS

Contact: Richard E Engdahl
Deposits and Composites, Inc.
318 Victory Drive
Herndon VA 22070
703/471-9310

Category: Combustion Engines & Components

Title: Ceramic Rotors and Vanes

Inventor: James C Withers
State/Country: VA
Company: Deposits and Composites, Inc.

Description: Technique for fabricating turbine rotors that will operate at high temperatures, thereby making it possible to operate at higher efficiencies.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 19, 1978 Award Date: May 24, 1978

Received by DOE from NBS: May 24, 1977 Final Report Accepted:

Status: Award Award Amount: $125,000

Development Stage: Engineering Design

Summary: A grant of $125,000 ($62,500 for each of two years) was awarded for the grantee to conduct a research program designed to improve the material properties of his Chemical Vapor Deposition (CVD) material for use in energy-related applications.

DOE # 32 DOE Coordinator D.R.Craig

OERI # 1176 DOE Program Off: CS

Contact: John C Calhoun, President
Forest Fuels, Inc.
P.O. Box #207
Antrim NH 03440
603/588-6773

Category: Fossil Fuels

Title: Wood Gas Reactor

Inventor: Robert A Caughey
State/Country: NH
Company: Forest Fuels, Inc.

Patent Applied For

Description: The device produces a fuel gas from wood suitable for use in existing gas or oil-fired combustion equipment.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 9, 1976 Award Date: May 1, 1979

Received by DOE from NBS: May 26, 1977 Final Report Accepted:

Status: Award Award Amount: $49,405

Development Stage: Prototype Development

Summary: $49,405 grant to design and build a gasifier system which will produce gaseous fuel from biomass. The unit will be used to demonstrate the practical use of alternate fuels in existing industrial boiler installations. Unit will be in demonstration service at Forest Fuel Technical Center, Antrim, New Hampshire.

DOE # 33 DOE Coordinator D. G. Mello
OERI # 908 DOE Program Off: CS

Contact: Joseph B Vogt
5391 Catrue Road
Attica MI 48412
313/724-0106

Category: Buildings, Structures & Components

Title: Temperature Indicating Device

Inventor: Joseph B Vogt
State/Country: MI
Company:

Patent Applied For

Description: Device to identify malfunction of steam trap.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 19, 1976
Completion Date: Aug 24, 1979
Received by DOE from NBS: May 31, 1977
Final Report Accepted: Nov 12, 1980
Status: Complete
Award Amount: $10,135
Development Stage: Engineering Design

Summary: A one year $10,135 grant to conduct an engineering development project to test and improve the operation of his temperature monitoring device.

DOE # 34 DOE Coordinator R.Bell
OERI # 1588 DOE Program Off: CS

Contact: John Eden

Category: Buildings, Structures & Components

Title: Delphic Thermogenic Paint (Heat Film)

Inventor: Hal Ellis
State/Country: FL
Company: Thermal Ventures, Inc.

Patent # 3 923 697 & Others

Description: A thin conductive paint containing crystalline graphite and pigments bonded to a surface such as Mylar with parallel busbar connections to 120/220v AC to be used as radiant heating.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 11, 1976
Decision Date:
Received by DOE from NBS: Jun 16, 1977
Final Report Accepted:
Status: Analysis I
Development Stage: Production & Marketing

Summary: The inventor is preparing a proposal outline a test program for his device, needed to develop a work plan, which at this date has not yet been received.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 35 DOE Coordinator D. G. Mello Contact: Gulab Chand Jain

OERI # 336 DOE Program Off: CS

Category: Direct Solar

Title: Utilization of Solar Energy by Solar Pond System

Inventor: Gulab Chand Jain
State/Country: India
Company: M/S Metro Rubber Works

Description: The proposal is for a solar pond demonstration plant.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 23, 1975 Decision Date:

Received by DOE from NBS: Jun 23, 1977 Final Report Accepted: Dec 12, 1977

Status: No DOE Support

Development Stage: Concept Development

Summary: Program has declined support of this invention because it does not respond to several significant problems which are inherent in the system that has been proposed.

DOE # 36 DOE Coordinator D. G. Mello Contact: Richard P Gingras
41 Kenoria Avenue
Danbury CT 06810
203/792-8877

OERI # 1283 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Computerstat

Inventor: Richard P Gingras Patent Applied For
State/Country: CT
Company: Dynamic Electronic Control Inc.

Description: Computerstat is a computerized thermostat set-back device that appears to be more energy-conserving than a conventional clock-thermostat.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 4, 1976 Completion Date: Feb 24, 1978

Received by DOE from NBS: Jun 24, 1977 Final Report Accepted:

Status: Complete Award Amount: $65,000

Development Stage: Engineering Design

Summary: Program office awarded a $65,000 grant to build, test and demonstrate the energy saving potential of, a microprocessor controlled thermostat, designed for use in residential and small commercial buildings. Grant also includes the design of a computer program to simulate operation in a small commercial building. Company subsequently has gone bankrupt.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 37 DOE Coordinator J.Aellen Contact: Lawrence E Sissell

OERI # 565 DOE Program Off: CS

Category: Miscellaneous

Title: Hotwater Engine

Inventor: Lawrence E Sissell Patent Applied For
State/Country: CA
Company:

Description: The proposal is for the production of mechanical power from low grade heat.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 2, 1976 Decision Date:

Received by DOE from NBS: Aug 5, 1977 Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: DOE/CS recommended that the inventor be assisted by providing a specialized, highly sophisticated computer analysis of his device. On October 19, 1977, OBP asked the inventor to submit a detailed work statement and cost estimate. The proposal submitted was determined to be too costly. OBP is negotiating a less costly analysis that will yield acceptable data.

DOE # 38 DOE Coordinator D. G. Mello Contact: John McCallum
5920 Beechview Drive
Worthington OH 43085
614/885-8416

OERI # 558 DOE Program Off: FE

Category: Industrial Processes

Title: Reduction volatilizations

Inventor: John McCallum
State/Country: OH
Company:

Description: The purpose of this invention is to produce volatile gases, liquids, and combustible coke at low temperatures, by passing pulverized coal through a eutectic molten metal bath of lead and sodium.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 2, 1976 Completion Date: Aug 21, 1978

Received by DOE from NBS: Aug 11, 1977 Final Report Accepted: Jul 1, 1979

Status: Complete Award Amount: $49,740

Development Stage: Prototype Development

Summary: $49,740 grant for 5 month study and experiment program. Study chemical reactions of the process, measure all variables, outline plan for design of prototype plant, examine economic feasibility of large scale production. Ohio State University is sub-contractor. Final report suggests that process is not economically feasible at this time.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

DOE # 39 DOE Coordinator G. R. Ellis Contact: James H Lawler

OERI # 219 DOE Program Off: FE

Category: Fossil Fuels

Title: Lawler Steam Generator and Lawler System of Thermal Oil
Recovery

Inventor: James H Lawler Patent # 3 943 732
State/Country: CA
Company:

Description: A small, high pressure, high temperature, mobile steam generator which can be economically operated at an oil well installation.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 29, 1975 Decision Date:

Received by DOE from NBS: Aug 18, 1977 Final Report Accepted: Feb 1, 1979

Status: No DOE Support

Development Stage: Engineering Design

Summary: On Feb. 1, 1979, the inventor was so advised, because his invention represented no advance in the state-of-the-art, and because having sold his equipment, he no longer had it available for test.

DOE # 40 DOE Coordinator G. R. Ellis Contact: Roland P Soule

OERI # 734 DOE Program Off: FE

Category: Other Natural Sources

Title: Improved Equipment and Process for Production of Blue Water
Gas

Inventor: Roland P Soule
State/Country: NY
Company:

Description: The main features of the invention are to use automatic valves for controlling the blue gas process, a square reactor bed with a rotating grate which will give positive ash removal -- all of which permits a faster cycling between the "run" and the "blow" of the process.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 9, 1976 Decision Date:

Received by DOE from NBS: Aug 18, 1977 Final Report Accepted:

Status: Decision Phase

Development Stage: Concept Development

Summary: Options for the support are being considered, a difficulty being that the inventor is not interested in personally pursuing the development of his invention. Tentative expressions of interest in the technology received from others are being made known to the inventor for his consideration. To date, he has declined as he was not interested in dealing with small companies, or he disagreed upon need for establishing economic and technically feasibility.

DOE # 41 DOE Coordinator D. G. Wells Contact: William P Armitage Jr

OERI # 180 DOE Program Off: CS

Category: Direct Solar

Title: Fabrication of Photovoltaic Devices by Solid Phase Growth
of Semi-conductors from Metal Layers

Inventor: William P Armitage, Jr.
State/Country: MA
Company:

Description: The purpose of the invention is to provide a more efficient and economical
process for fabricating solar cells.

Significant Dates, Status and Summary of Developments:

Form 1010 Rec'd by NBS: Jan 18, 1976 Decision Date:

Received by DOE from NBS: Aug 30, 1977 Final Report Accepted: Nov 7, 1978

Status: No DOE Support

Development Stage: Concept Development

Summary: Inventor failed to respond to repeated requests for an unsolicited proposal.
Inventor did not advise DOE on results of his earlier stated intentions to
survey private venture capital market.

DOE # 42 DOE Coordinator D.R.Craig

OERI # 347 DOE Program Off: CS

Contact: Everett Willard
4030 Irving Park Road
Chicago IL 60641
312/777-4030

Category: Buildings, Structures & Components

Title: Flue Baffle Assembly

Inventor: Everett Willard
State/Country: IL
Company: Temperature Heating Control Systems

Description: The invention is a baffle device to be inserted in hot air passage of old,
solid fuel-burning furnaces that have been converted to oil. The device
increases heat transfer and reduces fuel gas temperature, thereby saving fuel.

Significant Dates, Status and Summary of Developments:

Form 1010 Rec'd by NBS: Sep 3, 1975 Award Date: Sep 8, 1979

Received by DOE from NBS: Sep 23, 1977 Final Report Accepted:

Status: Award Award Amount: $30,000

Development Stage: Limited Production/Marketing

Summary: A $30,000 grant to perform a six-task study and survey of existing coal fired
heating systems that have been converted to oil and which may be modified
profitably to accept the inventor's energy saving flue baffle device.

DOE # 43 DOE Coordinator J. Aellen Contact: Sidney A Parker
5820 Diamond Oaks Dr., S
OERI # 1263 DOE Program Off: CS Fort Worth TX 76117

Category: Other Natural Sources

Title: Thermal Gradient Utilization Cycle

Inventor: Sidney A Parker Patent # 3 953 971
State/Country: TX
Company: The 21st Century Power Generation Co.

Description: The invention describes a new kind of power plant cycle using low grade, low temperature energy which does not need copious amounts of water for its operation.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 23, 1976 Completion Date: Sep 21, 1978

Received by DOE from NBS: Sep 30, 1977 Final Report Accepted: Aug 4, 1980

Status: Complete Award Amount: $40,000

Development Stage: Limited Production/Marketing

Summary: A $40,000 grant for one year was given to Mr. Parker, with support from Texas A&M, assessing the technical and economic feasibility of the thermal gradient utilization cycle when applied to selected energy conversion systems. Final report has been received. Inventor will make final report available to others in the trade and DOE.

DOE # 44 DOE Coordinator J. Aellen Contact: Leon Lazare
81 Willow Street
OERI # 1357 DOE Program Off: FE New Haven CT 06511
203/776-0256

Category: Miscellaneous

Title: New Working Fluids for Increasing the Cycle Efficiencies of Thermal

Inventor: Leon Lazare
State/Country: CT
Company: Pureq Company

Description: The invention is a new type of absorption refrigerator.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 24, 1976 Completion Date: May 17, 1978

Received by DOE from NBS: Sep 30, 1977 Final Report Accepted: May 1, 1979

Status: Complete Award Amount: $75,000

Development Stage: Engineering Design

Summary: A grant in the amount of $75,000 was awarded to research a dual-solvent system for heat pump application, and to determine phase relationships and thermodynamic properties of certain specific three-component systems.

DOE # 65 DOE Coordinator D. G. Mello
OERI # 1739 DOE Program Off: CS

Contact: Joe W Fowler
Carolina Thermal Company
Iron Works Road
Route #2, Box #29
Reidsville NC 27320
919/342-0352

Category: Industrial Processes

Title: Bulk Cure Tobacco Barn with Improvements

Inventor: Joe W Fowler
State/Country: NC
Company: Carolina Thermal Company

Patent Applied For

Description: The tobacco curing barn is a trailer-like structure that is fitted with a roof-top solar collector, a recuperator formed by the double roof structure, and the entire structure well insulated on all external walls and floor.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 19, 1977 Completion Date: May 31, 1979

Received by DOE from NBS: Sep 20, 1977 Final Report Accepted: Jun 1, 1979

Status: Complete Award Amount: $54,980

Development Stage: Limited Production/Marketing

Summary: A grant in the amount of $54,980 was awarded to manufacture, install on-site and demonstrate, a new type tobacco curing barn. Test data confirm this type barn yields significant energy savings compared to earlier designs and present industry standards. Final report has been received and accepted as meeting all the requirements of the grant.

DOE # 66 DOE Coordinator G. K. Ellis
OERI # 679 DOE Program Off: CS

Contact: David J Secunda
90 Prospect Hill Avenue
Summit NJ 07901
201/277-6675

Category: Industrial Processes

Title: Theson Dehydration

Inventor: David J Secunda
State/Country: NJ
Company:

Patent Applied For

Description: The process uses mechanical methods to reduce a liquid, containing the product to be dried, to a very fine spray of droplets, which are then carried to an air stream at ambient temperature, pressure and humidity so that some unidentified phenomenon, possibly surface evaporation, can cause crystallization.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 4, 1976 Completion Date: Dec 29, 1978

Received by DOE from NBS: Sep 23, 1977 Final Report Accepted: Aug 1, 1980

Status: Complete Award Amount: $47,660

Development Stage: Laboratory Test

Summary: A grant of $47,660 was awarded for the grantee to contract with TRW to make exploratory holograms and do some limited analysis, in order to assess the nature of the phenomena. The work has been completed, and the phenomenon found to be evaporation, but which occurs at room temperature without the deliberate addition of any external heat. Inventor is soliciting other support toward commercialization.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 47 DOE Coordinator G.K.Ellis Contact: Robert W Arthur
548 Prairie Road
OERI # 1773 DOE Program Off: CS Fond du Lac WI 54935
414/922-5703

Category: Industrial Processes

Title: Wastewater Aeration Power Control Device

Inventor: Robert W Arthur Patent # 3 740 320 & Others
State/Country: WI
Company: Arthur Technology, Inc.

Description: An on-line respirometer to measure the oxygen demand of microorganisms in waste water, and to regulate the power required for supplying the oxygen need to keep the organisms alive.

Significant Dates, Status and Summary of Developmental

Form 1019 Rec'd by NBS: Feb 7, 1977 Award Date: Jul 19, 1978

Received by DOE from NBS: Oct 25, 1977 Final Report Accepted:

Status: Award Award Amount: $58,200

Development Stage: Engineering Design

Summary: A grant in the amount of $58,200 has been awarded to develop a low-cost, less sophisticated model of the grantee's energy-saving on-line respirometer.

DOE # 48 DOE Coordinator D. G. Mello Contact: Werner E Hewald

OERI # 197 DOE Program Off: CS

Category: Combustion Engines & Components

Title: Hewald Combustor

Inventor: Werner E Hewald
State/Country: OH
Company:

Description: A fuel nozzle and chamber that pre-mixes air and fuel for more efficient, and less polluting combustion in aviation and automotive gas turbines.

Significant Dates, Status and Summary of Developmental

Form 1019 Rec'd by NBS: Jul 10, 1975 Completion Date:

Received by DOE from NBS: Nov 9, 1977 Final Report Accepted: Feb 8, 1979

Status: Complete

Development Stage: Laboratory Test

Summary: MIT Innovation Center provided inventor with technical review and analysis of support possibilities. MIT determined that the combustor designs were engineering improvement, not patentable. The scale of laboratory testing required to develop jet-engine combustors is beyond the scope of this program and is not being pursued in any DOE laboratory. Inventor was referred to private consulting firm which specializes in combustor design.

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          Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report
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      DOE  #     49     DOE Coordinator  D. G. Mello          Contact: Wayne S Beals

      OERI #   1192     DOE Program Off: CS

      Category: Buildings, Structures & Components

      Title: Automatic Control System for Water Heaters


      Inventor:  Wayne S Beals
      State/Country:  CA
      Company:

      Description:  Inventor is a valve to shut off water heater energy source, and to shut off
                    cold water input in the event of a burst tank. It may also be applicable to
                    solar systems.




      Significant Dates, Status and  Summary of Developments:

        Form 1019 Rec'd by NBS:     Jul 22, 1976      Decision Date:

        Received by DOE from NBS:   Oct 31, 1977      Final Report Accepted:   Sep  1, 1978

        Status:  No DOE Support

        Development Stage: Production Engineering

      Summary:      Small Scale Technology Office turned down the invention. It determined that
                    the device offered little or not net energy saving potential.  A manufacturer
                    of valves declined an offer of the technology citing marketing studies
                    indicating poor sales potential.  Program office stated that solar heating
                    system application was ineffective as conservation device.

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      DOE  #     58     DOE Coordinator  G. K. Ellis          Contact: Robert Cameron
                                                                       Scotsman Automotive Corp.
      OERI #     94     DOE Program Off: CS                            855 Sterling Avenue, Suite #8
                                                                       Palatine               IL  60067
      Category: Combustion Engines & Components                        312/991-5770

      Title: Scotsman Fuel Energizer


      Inventor:  Robert Cameron                                        Patent # 3 934 569
      State/Country:  IL
      Company:   Scotsman Automotive Corporation

      Description:  An accessory screen to atomize fuel in carburated internal combustion engines.




      Significant Dates, Status and  Summary of Developments:

        Form 1019 Rec'd by NBS:     Jul  2, 1975         Award Date:             Jul 11, 1978

        Received by DOE from NBS:   Nov 23, 1977      Final Report Accepted:

        Status:  Award                               Award Amount:   $74,579

        Development Stage: Production & Marketing

      Summary:      A grant of $74,579 was awarded to the grantee to determine the principles of
                    operation and to measure overall fuel saving performance of the device.  The
                    applicant's grant is currently the subject of investigation by the office of
                    the Inspector General.


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DOE # 51 DOE Coordinator D.R.Craig Contact: Richard B Bentley

OERI # 1116 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Thermal Efficiency Construction

Inventor: Richard B Bentley
State/Country: NY
Company:

Description: A method for building an energy-efficient residence, incorporating a counterflow heat exchanger, double-wall insulation, and other unique features. Copyright plans sold under license.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 19, 1976 Decision Date:

Received by DOE from NBS: Dec 20, 1977 Final Report Accepted:

Status: Analysis II

Development Stage: Concept Development

Summary: Recommendation under evaluation in DOE. Inventor preparing revised proposal based on discussion with program engineer. In July '78 inventor advised DOE of his intention to prepare a proposal. Nothing has been received to date. Inventor reports he has applied for a grant under the Appropriate Technology Program.

DOE # 52 DOE Coordinator G. K. Ellis Contact: Sherman R Janney

OERI # 172 DOE Program Off: CS

Category: Transportation Systems, Vehicles & Components

Title: Air Wedge

Inventor: Robert G Landry (Deceased) Patent # 3 740 320
State/Country: NE
Company:

Description: The device is an aerodynamic drag device for use with trucks, mounted on the front face of the trailer or the cargo box.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 13, 1975 Decision Date:

Received by DOE from NBS: Dec 21, 1977 Final Report Accepted: Nov 28, 1979

Status: No DOE Support

Development Stage: Concept Development

Summary: On November 28, 1979, the inventors were advised that there is no basis for DOE support because there are devices already installed on trucks on the highway, which accomplish the same purpose.

DOE # 53 DOE Coordinator D.G.Mello

OERI # 2070 DOE Program Off: CS

Contact: Harry E Wood
6605 Oakland Drive
New Orleans LA 70118
504/488-7853

Category: Buildings, Structures & Components

Title: High Efficiency Water Heater

Inventor: Harry E Wood
State/Country: LA
Company: Harry E Wood & Assoc.

Patent Applied For

Description: a direct contact, gas-fired hot water heater that can extract the latent heat of the water vapor formed during combustion.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 15, 1977 Completion Date: May 1, 1978

Received by DOE from NBS: Dec 23, 1977 Final Report Accepted: Mar 1, 1979

Status: Complete Award Amount: $72,600

Development Stage: Prototype Development

Summary: A grant in the amount of $72,600 was awarded to assist inventor in installing a direct contact, gas fired hot water heating in an existing 210 unit apartment building, and measuring system characteristics, efficiency and reliability. The results assist inventor in further development and commercialization. Apartment owner is buying additional heaters and inventor is negotiating licensing or other arrangements with third parties.

DOE # 54 DOE Coordinator D. G. Mello

OERI # 1355 DOE Program Off: CS

Contact: Edward Perry Sikes, Jr.
Optimizer Control Corp.
Suite #104, 201 Burnside Pkwy
Burnsville MN 55337
612/894-3610

Category: Combustion Engines & Components

Title: Optimizer

Inventor: Paul H Schweitzer (Deceased)
State/Country: PA
Company: Optimizer Control Corp.

Patent # 3 976 412 & Others

Description: A closed-loop electronic ignition for automobile engines. Spark advance is optimized for maximum power output, and minimum fuel consumption.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 25, 1976 Award Date: Sep 1, 1978

Received by DOE from NBS: Jan 11, 1978 Final Report Accepted:

Status: Award Award Amount: $88,895

Development Stage: Working Model

Summary: $88,895 grant for one-year program to design, develop, fabricate and test a pilot model of the Optimizer. Pennsylvania State University will sub-contract electronic design tasks and analytical evaluation. First progress report indicates that prototype performs as predicted. Penn. State Univ. has been assigned greater role in development of instrumentation and additional test units.

DOE # 55 DOE Coordinator R.Bell Contact: Richard D Palone

OERI # 2923 DOE Program Off: ET

Category: Fossil Fuels

Title: Electrically Heated Sucker-Rod

Inventor: Richard D & Chester Palone Patent # 3 889 503
State/Country: AR
Company:

Description: An electric heater in the sucker rod used to drive a pump at the bottom of an oil well. Intended to prevent paraffin from congealing and restricting flow, thus avoiding consequent costly maintenance cleanout.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 22, 1977 Decision Date:

Received by DOE from NBS: Jan 30, 1978 Final Report Accepted: Dec 29, 1980

Status: No DOE Support

Development Stage, Concept Development

Summary: This invention received a favorable review within DOE. During the last contact with the inventor, he said he had located an interested subcontractor and would soon be submitting a proposal requesting a DOE grant. Inventor advised on December 29th, 1980 that he no longer needed any grant money.

DOE # 56 DOE Coordinator G.K.Ellis Contact: William P Boulet & Associates
Quality Industries
3308 Tulane Avenue
Suite #312
New Orleans LA 70114
504/821-8699

OERI # 2238 DOE Program Off: CS

Category: Industrial Processes

Title: Flexaflo-The Wet Fuel Dryer

Inventor: William P Boulet Patent # 3 976 018
State/Country: LA
Company: Quality Industries

Description: A dryer/boiler using sugarcane waste (bagasse) for fuel; exhaust gases from process are used to "pre-dry" fuel prior to entering boiler.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 24, 1977 Completion Date: Sep 1, 1978

Received by DOE from NBS: Mar 31, 1978 Final Report Accepted: Apr 1, 1979

Status: Complete Award Amount: $111,220

Development Stage: Prototype Test

Summary: A $111,220 grant for nine months to Quality Industries, Inc. To modify the existing dryer by designing, building, installing, operating, and testing a sealing system and a system to control airborne bagacillo. The design modifications were successfully incorporated and testing indicated a considerable operating economy. Owner is investigating marketing alternatives.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 57 DOE Coordinator G. R. Ellis

OERI # 274 DOE Program Off: CS

Contact: Robert M Wicken
411 Betty Lane, West
Saint Paul MN 55118
612/457-8827

Category: Buildings, Structures & Components

Title: X-5 Smoke Eliminator

Inventor: Robert M Wicken
State/Country: MN
Company:

Patent # 3 912 297

Description: A two-stage combustion chamber suitable for adapting existing incinerators to meet current EPA pollution requirement.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 23, 1975 Award Date: Mar 27, 1979

Received by DOE from NBS: Mar 31, 1978 Final Report Accepted:

Status: Award Award Amount: $55,000

Development Stage: Prototype Development

Summary: A grant of $55,000 was awarded for the grantee to convert the X-5 Smoke Eliminator from its existing use as a gas burner to the burning of all grades of fuel oil.

DOE # 58 DOE Coordinator D. G. Mello

OERI # 1922 DOE Program Off: CS

Contact: Charles W Kirk
1965 Arrowhead Lane, NE
Saint Petersburg FL 33703
813/529-7878

Category: Transportation Systems, Vehicles & Components

Title: A Multiple Spark System Using Inductive Storage

Inventor: Charles W Kirk
State/Country: FL
Company:

Patent Applied For

Description: Multiple spark system using a gated series of spark discharges on a single plug, to improve the fuel economy of a spark-ignition engine, by reducing the misfire rate.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 10, 1977 Award Date: Feb 26, 1979

Received by DOE from NBS: Mar 31, 1978 Final Report Accepted:

Status: Award Award Amount: $59,079

Development Stage: Prototype Test

Summary: $59,079 grant to manufacture ten (10) prototype "MSS" units. Three units will be installed on selected vehicles and dynamometer tested at University of Florida. Final results will be submitted to EPA for verification in EPA drive test cycle.

DOE # 60 DOE Coordinator G. K. Ellis Contact: Bernard Zimmern

OERI # 1680 DOE Program Off: CS

Category: Combustion Engines & Components

Title: The Volumetric Gas Turbine

Inventor: Bernard Zimmern
State/Country: France
Company:

Description: A positive displacement, modified Brayton cycle engine, for use primarily in automobiles.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 15, 1976 Decision Date:

Received by DOE from NBS: Apr 12, 1978 Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: Inventor is waiting to submit a statement of work until locating other sources of substantial supplemental support needed to finish development of the concept

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DOE # 60 DOE Coordinator D. G. Mello

OERI # 1654 DOE Program Off: CS

Category: Miscellaneous

Title: Electric Transport Refrigerator

Contact: William H Cone
Coneco, Inc.
1151 Meadow Lane, 43
Waterloo IA 50701
319/233-6224

Inventor: William H Cone
State/Country: IA
Company: Coneco, Inc.

Patent # 3 770 651 & Others

Description: Prime mover engine of Refrigerated Truck is modified to function as an A.C. Generator as well as being an engine. Electricity produced, powers sealed refrigerator on trailer, replacing present diesel-powered refrigeration unit.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 13, 1976 Completion Date: Sep 25, 1978

Received by DOE from NBS: Apr 28, 1978 Final Report Accepted: Apr 9, 1980

Status: Complete ✓ Award Amount: $50,000

Development Stage: Prototype Test

Summary: A grant of $50,000 was awarded for one-year design, development, and testing of Invention. Iowa State University was sub-contractor for electronic design tasks. Inventor procured a diesel engine for test and modification. Grantee completed all tasks except in-service demonstration. Technical problems with inventor design prevented performance of last task. Inventor plans to seek private funds for continuation of project.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 61 DOE Coordinator G. K. Ellis Contact: Harry S. Lackey

OERI # 1088 DOE Program Off: FE

Category: Industrial Processes

Title: Fuel Preparation Process

Inventor: Willing B Foulke Patent # 3 932 145
State/Country: DE
Company: Fluid Coal Corp.

Description: A method for separating mineral matter from coal using a flotation process.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 14, 1976 Decision Date:

Received by DOE from NBS: Apr 28, 1978 Final Report Accepted:

Status: Procurement

Development Stage: Concept Development

Summary: The invention coordinator and the inventor have agreed on scope of work for a grant.

DOE # 62 DOE Coordinator D.R.Craig

OERI # 1029 DOE Program Off: ET

Contact: Thaddeus Papis
10115 Victoria Avenue
Riverside CA 92503
714/689-5041

Category: Miscellaneous

Title: Tapered Plate Annular Matrix

Inventor: Thaddeus Papis
State/Country: CA
Company:

Description: A compact heat tube exchanger that offers significant improvement over conventional shell-and-tube exchangers, especially for very high pressure applications.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 28, 1976 Award Date: Jun 22, 1979

Received by DOE from NBS: Apr 28, 1978 Final Report Accepted:

Status: Award Award Amount: $79,800

Development Stage: Production Engineering

Summary: Grant of $79,800 has been awarded for the inventor to analyze the potential uses, energy-related benefits, production techniques, and comparative economics of the heat exchanger. The study will culminate in the definition of, and a plan for, a hardware demonstration program.

DOE # 63 DOE Coordinator R. Bell
OERI # 1330 DOE Program Off: CS

Contact: Thomas LoGiudice
520 East 72d Street
New York NY 10021

Category: Buildings, Structures & Components

Title: Fluorobulb

Inventor: Thomas LoGiudice
State/Country: NY
Company:

Patent # 3 953 761

Description: Fluorescent bulb designed to directly replace an incandescent bulb. 20 watt bulb and ballast can be easily separated. Built on Edison screwbase.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 13, 1976
Award Date: Apr 10, 1979
Received by DOE from NBS: May 3, 1978
Final Report Accepted:
Status: Award
Award Amount: $49,500
Development Stage: Prototype Development

Summary: A grant of $49,500 has been awarded for research and product development. Grantee will produce ten prototype bulbs, investigate problems of uniform coating, produce certified data regarding lamp efficiency, luminous efficiency and accurate cost data for predicting production quantity costs.

DOE # 66 DOE Coordinator G. K. Ellis
OERI # 2543 DOE Program Off: CS

Contact: Shalom Mahalla
P.O. Box #11103
Phoenix AZ 85001
602/277-7503

Category: Industrial Processes

Title: The Mahalla Process--A Hydrometallurgical Method for Extracting Copper

Inventor: Shalom Mahalla
State/Country: AZ
Company:

Patent Applied For

Description: A hydrometallurgical process for refining copper that eliminates the electrorefining step.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 1, 1977
Award Date: Sep 1, 1979
Received by DOE from NBS: May 8, 1978
Final Report Accepted:
Status: Award
Award Amount: $88,033
Development Stage: Laboratory Test

Summary: A grant of $88,033 has been awarded to complete the laboratory-scale development and to optimize the effect of the following process variables: initial concentration of copper in the solution, solution pH, initial area of Fe exposed to the solution, reaction time, and cell configuration. In addition, the grantee will identify any other process variables. Finally, he will process a standard leach liquor to determine the efficiency of copper separation.

DOE # 65 DOE Coordinator R.Bell

OERI # 741 DOE Program Off: CS

Category: Miscellaneous

Title: WattVender

Contact: Lee A Henningsen
Firetrol, Inc.
1617 Cascade Street
Erie PA 16502
814/459-1770

Inventor: Lee A Henningsen
State/Country: PA
Company: Firetrol, Inc.

Description: A coin operated device for dispensing electricity.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 18, 1976 Award Date: Sep 10, 1979

Received by DOE from NBS: May 12, 1978 Final Report Accepted:

Status: Award Award Amount: $55,000

Development Stage: Prototype Test

Summary: $55,000 grant to manufacture and install sufficient units to completely convert Hillman Ferry Campground (TVA operated) from free to metered electric service. TVA will record user reactions, electric usage before and after, and operate units in one year demonstration program.

DOE # 66 DOE Coordinator D.G.Mello

OERI # 2277 DOE Program Off: CS

Category: Industrial Processes

Title: Heat Extractor

Contact: Daniel Ben-Shmuel, President
Heat Extractor Corporation
P.O. Box #455
Johnstown NY 12095
518/762-3121

Inventor: Philip Zacuto
State/Country: NY
Company: Heat Extractor Corp.

Description: A system for recovering "Waste Heat" from industrial combustion processes by using water in direct contact with combustion products and an auxiliary heat exchanger.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 20, 1977 Award Date: Sep 29, 1978

Received by DOE from NBS: May 26, 1978 Final Report Accepted:

Status: Award Award Amount: $125,000

Development Stage: Prototype Test

Summary: A $125,000 grant for one year to install, operate and test a heat extractor in an operating paper mill in cooperation with Mohawk Paper Mills Inc. Included in the grant are funds for research and development to determine adaptations required for the heat extractor to be used in coal fired boilers. Operation and tests in the Mohawk Paper Mill are complete. Results confirm significant reduction in primary fuel requirements.

DOE # 67 DOE Coordinator G. K. Ellis

OERI # 790 DOE Program Off: CS

Contact: James A Browning
Browning Engineering Corp.
P.O. Box #863
Hanover NH 03755
603/298-8400

Category: Other Natural Sources

Title: Windmill Using Hydraulic System for Energy Transfer and Speed Control

Inventor: James A Browning
State/Country: NH
Company: Browning Engineering Corp.

Patent Applied For

Description: A windmill design based on a hydraulic system for wind energy, particularly suited for low to medium speed winds.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 5, 1976 Award Date: Dec 7, 1979

Received by DOE from NBS: Jun 20, 1978 Final Report Accepted:

Status: Award Award Amount: $39,000

Development Stage: Prototype Development

Summary: A grant in the amount of $39,000 has been awarded to complete the construction of the grantee's 70-ft diameter hydraulic windmill, and then to test it.

DOE # 68 DOE Coordinator R. Bell

OERI # 631 DOE Program Off: CS

Contact: Charlie Seziel

Category: Buildings, Structures & Components

Title: Under Compression and Over Compression Free Helical Screw Rotary Compressor

Inventor: Leroy W Blazett
State/Country: VA
Company: Dunham Bush, Inc.

Patent # 3 936 239

Description: A compressor for use in medium-to-large sized heat pump-air conditioning systems.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 22, 1976 Decision Date: Oct 1, 1979

Received by DOE from NBS: Jun 28, 1978 Final Report Accepted:

Status: Other Assistance

Development Stage: Prototype Development

Summary: As a result of the National Bureau of Standards recommendation, and in consideration of an unsolicited proposal from the grantee, the CS Division of DOE has initiated a procurement leading to a two year contract funded presently $300,000. The Energy-Related Inventions Program will not participate further regarding this invention.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 69 DOE Coordinator G. K. Ellis

OERI # 846 DOE Program Off: CS

Contact: Enoch J Durbin
Instrumentation & Control Lab.
Aero Lab., Forrestal Campus
Princeton University
Princeton NJ 08540
609/452-5154

Category: Combustion Engines & Components

Title: Ionic Fuel Control System for the Internal Combustion Engine

Inventor: Enoch J Durbin
State/Country: NJ
Company:

Patent # 3 470 741

Description: A system for controlling the air-fuel ratio of a gasoline internal combustion engine to maintain lean operation, improved fuel economy, and good performance.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 25, 1976 Completion Date: Jan 2, 1979

Received by DOE from NBS: Jun 29, 1978 Final Report Accepted:

Status: Complete Award Amount: $87,051

Development Stage: Prototype Development

Summary: A grant of $87,051 was awarded to develop the Ionic Fuel Control System and to assess its commercial feasibility. A successful prototype was developed and is being considered by several automobile manufacturers.

DOE # 70 DOE Coordinator J. Aellen

OERI # 2847 DOE Program Off: CS

Contact: Kenneth A Stofen
3642 Country Avenue
Racine WI 53405
414/554-7987

Category: Miscellaneous

Title: Air Cooled Compressor Heat Recovery and Heat Circulation System plus Ambient Air Filter and Air Cleaner

Inventor: Kenneth A Stofen
State/Country: WI
Company: Ken Stofen Associates

Patent Applied For

Description: A heat recovery system for large compressors.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 21, 1977 Completion Date: Feb 13, 1979

Received by DOE from NBS: Jun 28, 1978 Final Report Accepted: Aug 5, 1980

Status: Complete Award Amount: $53,000

Development Stage: Limited Production/Marketing

Summary: A grant in the amount of $53,000 was awarded to design and build ecology cabinets; and then assemble, operate, and test air cooled compressor systems in environments with particulate-laden and high temperature air. Final report received. Inventor is searching for venture capital and marketing assistance.

DOE # 71 DOE Coordinator D. G. Hollo Contact: Arleigh Wangler

OERI # 2538 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Knight Guard

Inventor: Arleigh Wangler Patent Applied For
State/Country: CA
Company:

Description: A system for remote controlling the lighting in a building by means of low frequency radio signals.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 10, 1977 Decision Date:

Received by DOE from NBS: Jun 29, 1978 Final Report Accepted: Sep 1, 1978

Status: No DOE Support

Development Stage: Limited Production/Marketing

Summary: Inventor is investigating law enforcement agencies' interest. Product is better suited to that field than to energy conservation.

DOE # 72 DOE Coordinator G. K. Ellis Contact: Basil W Bella

OERI # 733 DOE Program Off: ET

Category: Industrial Processes

Title: Utilization of Waste Gas for Boilers and Furnaces in Refineries and Petrochemical Plants

Inventor: Joe Agar
State/Country: TX
Company: Redland Automation

Description: System exploits the relationship between specific gravity of the flare gas and its BTU content, to compute BTU per hour and subsequently control the fuel-air ratio of boilers.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 8, 1976 Decision Date:

Received by DOE from NBS: Jun 28, 1978 Final Report Accepted: Aug 5, 1980

Status: No DOE Support

Development Stage: Laboratory Test

Summary: A procurement request for a grant was initiated on April 20, 1979. Shortly thereafter, Mr. Agar sold the company and the new manager indicated that the earlier proposal was not in accord with the company's new goals. Then, on Dec 28 1979, the company advised by telephone that they were not interested in pursuing the development at all, since it did not coincide with their company's new goals. Formal notification was received in an August 5, 1980 letter.

DOE # 73 DOE Coordinator G. K. Ellis

OERI # 1323 DOE Program Off:

Category: Buildings, Structures & Components

Title: U-Form Technology

Contact: Melvin M Sachs
U-Form Systems & Tech., Inc.
29200 Vassar Ave., Suite #700
Livonia MI 48152
313/478-0800

Patent # 3 800 015 & Others

Inventor: Melvin M Sachs
State/Country: MI
Company: U-Form Systems & Tech., Inc.

Description: A system which uses light-weight aggregate insulation to provide the form-work for the concrete structural members of a building, with pre-finished exterior and interior surfaces.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 9, 1976 Award Date: Jun 22, 1979

Received by DOE from NBS: Aug 10, 1978 Final Report Accepted:

Status: Award Award Amount: $87,230

Development Stage: Production & Marketing

Summary: Grant of $87,230 was awarded for the purpose of contracting with Underwriters Laboratories, Inc. to perform fire tests, and to contract with Lev Zetlin Consultants for structural testing and analysis. This invention won the "Outstanding Individual Inventor" award from the Dvorkovitz Technology Show of 1980.

DOE # 76 DOE Coordinator J. G. Wells

OERI # 2860 DOE Program Off: ER

Category: Direct Solar

Title: A Solid Electrolyte Galvanic Solar Energy Conversion Cell

Contact: G. R. Fitterer, President
Scientific Applications, Inc.
825 Twelfth Street
Oakmont PA 15139
412/828-2450

Patent Applied For

Inventor: G R Fitterer
State/Country: PA
Company: Scientific Applications, Inc.

Description: A high-temperature, high voltage (1.81V) fuel cell utilizing a unique calcium stabilized zirconia solid electrolyte. Device promises high efficiency, minimum environmental problems and wide application. It can also simultaneously produce chemical feedstock.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 19, 1977 Completion Date: Aug 24, 1979

Received by DOE from NBS: Aug 29, 1978 Final Report Accepted: Oct 30, 1980

Status: Complete Award Amount: $50,000

Development Stage: Laboratory Test

Summary: A $50,000 grant to conduct a two-part research project to investigate the characteristics of his Fuel Cell. Part one is a study of the primary cell and its voltage characteristics. Part two is research leading to selection of the best electrolyte.

DOE # 75 DOE Coordinator G. K. Ellis
OERI # 2365 DOE Program Off: CS

Contact: Richard Joblin
Station #1, Box #B-1
Wrightsville Beach NC 28480
919/256-4933

Category: Industrial Processes

Title: Coke Quenching Steam Generator

Inventor: Richard Joblin
State/Country: NC
Company:

Patent Applied For

Description: The steam generator is a direct contact heat exchanger for generation of process steam from hot coke.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 6, 1977
Award Date: May 14, 1979
Received by DOE from NBS: Aug 29, 1978
Final Report Accepted:
Status: Award
Award Amount: $119,400
Development Stage: Laboratory Test

Summary: A grant of $119,400 was awarded to pursue a program of laboratory scale and pilot plant scale development. Laboratory stage has been successfully completed and the grantee has proceeded to the pilot plant stage.

DOE # 76 DOE Coordinator G.K.Ellis
OERI # 2075 DOE Program Off: CS

Contact: Donald R Ross
3344 South Grove
Fort Worth TX 76110
817/921-9671

Category: Industrial Processes

Title: The Ross Furnace

Inventor: Donald R Ross
State/Country: TX
Company: Ross Research Company

Patent Applied For

Description: A new gas burner design for use in high temperature industrial process furnaces.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 18, 1977
Award Date: Apr 14, 1979
Received by DOE from NBS: Sep 18, 1978
Final Report Accepted:
Status: Award
Award Amount: $82,000
Development Stage: Prototype Test

Summary: A grant in the amount of $82,000 was awarded to build, assemble, operate and test two systems: one for a tilted furnace and one for a rotary furnace. Data analysis will include estimated production scale BTU per ton, production rates, fuel efficiency, energy balance, and material balance.

DOE # 77 DOE Coordinator: J. Aellen
OERI # 1173 DOE Program Off: CS
Category: Miscellaneous
Title: Variable Heat Refrigeration System

Contact: James W McCord
Corpane Industries, Inc.
250 Production Court
Bluegrass Industrial Park
Louisville KY 40299
502/491-4433

Inventor: James W McCord
State/Country: KY
Company: Corpane Industries, Inc.

Patent Applied For

Description: An improved vapor degreasing system incorporating a heat pump to conserve energy, retain solvents, and reduce hazards associated with solvent vapors.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 9, 1976 Award Date: Feb 1, 1979

Received by DOE from NBS: Sep 25, 1978 Final Report Accepted:

Status: Award Award Amount: $97,400

Development Stage: Working Model

Summary: An award in the amount of $97,400 has been granted to design and construct demonstration models of the variable heat refrigeration system.

DOE # 78 DOE Coordinator G. K. Ellis Contact: Robert McNeill
OERI # 1154 DOE Program Off: ER
Category: Other Natural Sources
Title: System for High Efficiency Power Generation from Low Temperature Sources

Inventor: Robert McNeill
State/Country: CA
Company:

Description: Concept for reducing the heat sink temperature in power plant operation and other applications; ice would be generated during cold weather and used to reduce the heat sink temperature during warmer weather.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 30, 1976 Decision Date:

Received by DOE from NBS: Sep 28, 1978 Final Report Accepted: Mar 11, 1981

Status: No DOE Support

Development Stage:

Summary: Inventor advised that DOE support is no longer needed.

DOE # 79 DOE Coordinator G. K. Ellis Contact: Marvin L Wahrman
47 Red Rock
OERI # 1732 DOE Program Off: FOSSIL Irvine CA 92714
714/979-1280

Category: Fossil Fuels

Title: Oil Well Bit Insert (Teeth), Cutting Article, Ablative

Inventor: Marvin L Wahrman Patent Applied For
State/Country: CA
Company:

Description: A new composite bit insert to replace the tungsten carbide inserts now commonly used in the rotary cone cutter bits for oil and gas well drillings. It is claimed to have sharper edges, more resistant to wear, and to be stronger.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 21, 1977 Completion Date: Sep 29, 1979

Received by DOE from NBS: Aug 25, 1978 Final Report Accepted: Jan 29, 1981

Status: Complete Award Amount: $57,150

Development Stage: Prototype Test

Summary: A $57,150 grant was awarded to prove the technical feasibility of the new bit inserts as relates to their performance, and to address the repeatability and controlability of the manufacturing process.

DOE # - 80 DOE Coordinator D.R.Craig Contact: Patsie C Campana

OERI # 1964 DOE Program Off: CS

Category: Industrial Processes

Title: Improved Unfired Refractory Brick

Inventor: Patsie C Campana
State/Country: OH
Company:

Description: Chemically bonded, unfired, brick for ladles handling molten steel, consisting of 90% silica and containing 10% clay with minor amounts of hardening agent and Gulac.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 18, 1977 Decision Date:

Received by DOE from NBS: Sep 28, 1978 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: A proposal has been received from the inventor for several million dollars to build a production facility. He was advised the program was unable to fund capital equipment, and potential alternatives of business plan and marketing study were described. But, to date, the inventor has indicated little interest except on the basis of a large grant for capital equipment.

DOE # 81 DOE Coordinator D. G. Mello

OERI # 2226 DOE Program Off: CS

Contact: C Richard Panico
Xenon Corporation
66 Industrial Way
Wilmington MA 01887
617/658-8940

Category: Industrial Processes

Title: Flash Polymerization

Inventor: C Richard Panico
State/Country: MA
Company: Xenon Corp.

Patent # 3 782 889

Description: A process utilizing pulsed xenon arc discharge lamps for polymerizing thermosetting resins.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 26, 1977 Completion Date: Sep 29, 1979

Received by DOE from NBS: Sep 29, 1978 Final Report Accepted: Feb 7, 1981

Status: Complete Award Amount: $99,990

Development Stage: Prototype Test

Summary: A $99,990 grant to conduct a three-part investigation of the energy-saving, and market penetration potential for this curing technique. United Technologies, Inc., Research Laboratories, as a subcontractor, will conduct a preliminary assessment of the basic mechanism of flash initiated reactions. Development Sciences, Inc. will conduct a comparative energy analysis, and market penetration study.

DOE # 82 DOE Coordinator D. G. Mello

OERI # 3661 DOE Program Off: CS

Contact: Robert L Ullrich
Ullrich Eng. & Mfg., Inc.
1717 East Second Street
Roswell NM 88201
505/622-1621

Category: Industrial Processes

Title: Cool Air Induction

Inventor: Robert L Ullrich
State/Country: NM
Company: Ullrich Engineering & Mfg., Inc.

Description: Modification kit for engines used for powering irrigation pumps. Uses cool well water in air cooler placed between commercial supercharger and the engine.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 23, 1977 Award Date: Sep 24, 1979

Received by DOE from NBS: Oct 27, 1978 Final Report Accepted:

Status: Award Award Amount: $68,402

Development Stage: Production Engineering

Summary: A two-phase grant in the amount of $99,282 has been requested. The first phase has been awarded ($68,402) and provides for analysis of existing operating data, a survey of the potential market, development and comparison of alternate strategies and a preparation of a formal business plan.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 93 DOE Coordinator D.R.Craig Contact: Charles James Bier

OERI # 2821 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Vertical Solar Louvers

Inventor: Charles James Bier
State/Country: VA
Company:

Description: Massive Rectangular Columns oriented in NE-SW direction, located indoors behind a glazed southern exposure. Aesthetic improvement over conventional TROMBE wall should lead to increased acceptance of passive solar heating.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 17, 1977 Decision Date: May 1, 1979

Received by DOE from NBS: Oct 27, 1978 Final Report Accepted: Feb 28, 1981

Status: Other Assistance

Development Stage: Concept Development

Summary: Inventor was referred to Chicago office of DOE Passive Solar Technology for consideration of a grant under a competitive solicitation advertised by that office. Inventor did not receive a contract. There is no basis for a grant award by this office.

DOE # 84 DOE Coordinator J.Aellen Contact: Kenneth W Odil

OERI # 2032 DOE Program Off: CS

Category: Industrial Processes

Title: Kinetic Energy Type Pumping System

Inventor: Kenneth W Odil Patent # 3 123 009
State/Country: TX
Company:

Description: Simplified pumping system utilizes the kinetic energy of a circulating fluid to reduce the bottom-hole pressure and to lift the down-hole fluid.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 11, 1977 Decision Date:

Received by DOE from NBS: Oct 30, 1978 Final Report Accepted:

Status: Analysis II

Development Stage: Prototype Test

Summary: A proposal was received from the inventor which is unacceptable because it is considerably beyond the level of funds support available. Inventor has been so advised and is endeavoring to find a cost sharing arrangement with an interested private industry. A 9/19/80 check with him indicated that he believed he was making some progress in his discussions with others on cost sharing.

DOE # 85   DOE Coordinator R.Bell   Contact: Charles G Kalt

OERI # 3691   DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Dielectric Windowshade

Inventor: Charles J Kalt   Patent # 3 989 257
State/Country: MA
Company:

Description: An applied voltage causes an aluminized mylar film sheet to unroll and press flat against a window which is coated with an electrically conducting material. The film retards heat transfer throughthe window. Removing the voltage allows the film to roll up.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 12, 1978   Decision Date:

Received by DOE from NBS: Oct 31, 1978   Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: Recommendation under consideration by DOE. Inventor investigating other, non-government opportunities. Inventor has been informed that he has until May 30, 1981 to submit a preliminary proposal into the DOE or his invention will no longer be considered for a grant.

DOE # 86   DOE Coordinator S. K. Ellis   Contact: Stephen M Baum, President
Diamond Energy Corporation
530 Fifth Avenue
New York   NY 10036
212/944-5990

OERI # 2726   DOE Program Off: CS

Category: Fossil Fuels

Title: Coke Desulfurization

Inventor: Douglas MacGregor   Patent # 4 011 303
State/Country: UT
Company: Diamond Energy Corporation

Description: Method to remove sulfur from high sulfur coal during the coking process, which makes it possible to use high sulfur coals in the manufacture of metallurgical coke.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 21, 1977   Completion Date: Dec 7, 1979

Received by DOE from NBS: Nov 27, 1978   Final Report Accepted: Feb 4, 1981

Status: Complete   Award Amount: $82,500

Development Stage: Laboratory Test

Summary: A grant of $82,500 was awarded on Dec 7, 1979 for Diamond West Corporation, exclusive licensee, to perform sufficient additional technical, engineering, and application investigation to ready the technology for the marketplace.

DOE # 87 DOE Coordinator J. Aellen

OERI # 2224 DOE Program Off: CS

Contact: Ruel C Terry
3090 South High Street
Denver CO 80210
303/798-3320

Category: Industrial Processes

Title: Recovering Uranium From Coal In Situ

Inventor: Ruel C Terry
State/Country: CO
Company:

Patent # 4 113 313

Description: A method for recovering uranium from the sites of depleted coal deposits that have been mined by in situ gasification.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 17, 1977 Award Date: Feb 6, 1980

Received by DOE from NBS: Nov 29, 1978 Final Report Accepted:

Status: Award Award Amount: $85,240

Development Stage: Laboratory Test

Summary: A grant in the amount of $85,240 has been awarded to reduce two of the uncertainties related to eventual commercialization of the process. The first uncertainty concerns potential sites and the second uncertainty relates to technical feasibility.

DOE # 88 DOE Coordinator D. G. Mello

OERI # 1818 DOE Program Off: CS

Contact: Lawrence Ladin
c/o Compressor Controls Corp.
115 Southwest Eighth Street
Des Moines IA 50309
515/244-1180

Category: Fossil Fuels

Title: System-100

Inventor: Alex Rutshein, et al
State/Country: IA
Company: Compressor Controls Corp.

Patent Applied For

Description: A strategy (control system) for regulating centrifugal and reciprocating equipment used in natural gas compressor stations.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 10, 1977 Award Date: Aug 12, 1980

Received by DOE from NBS: Nov 30, 1978 Final Report Accepted:

Status: Award Award Amount: $50,000

Development Stage: Concept Development

Summary: A grant in the amount of $50,000 has been awarded to develop microprocessor for control of compressors in gas transmission pipelines. Major compressor manufacturer will evaluate and test final product for consideration of large-scale utilization.

DOE # 89 DOE Coordinator: D.R.Craig Contact: Henry E. Allen

OERI # 2640 DOE Program Off: CS

Category: Industrial Processes

Title: Continuous Casting Process and Apparatus

Inventor: Henry E Allen Patent # 3 517 729
State/Country: NY
Company: Technicon Corp.

Description: A continuous horizontal casting process for steel billets, slabs, and tubing, which achieves a very high quality product at twice the speed of existing continuous casting processes.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 22, 1977 Decision Date:

Received by DOE from NBS: Nov 30, 1978 Final Report Accepted: Feb 28, 1981

Status: No DOE Support

Development Stage: Prototype Development

Summary:

DOE # 90 DOE Coordinator: J.Aellen Contact: Clinton Van Winkle

OERI # 3790 DOE Program Off: CS

Category: Industrial Processes

Title: Grain Dryer

Inventor: Clinton Van Winkle Patent # 4 003 139
State/Country: NE
Company:

Description: A device to be added to a grain combine, to utilize the exhaust energy from the combine engine for drying the grain in the combine hopper tank.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 16, 1978 Decision Date:

Received by DOE from NBS: Dec 18, 1978 Final Report Accepted:

Status: Analysis I

Development Stage: Prototype Development

Summary: Recommendation under consideration by DOE

DOE # 91 DOE Coordinator R. Bell

OERI # 3210 DOE Program Off: FE

Category: Fossil Fuels

Title: Mine Brattice

Contact: Ross Kinney, Atty.
Bagby Brattices, Inc.
P.O. Box 4969
Greenville KY 42345
502/338-5619

Patent # 3 972 272

Inventor: James Allen Bagby
State/Country: KY
Company: Bagby Brattices, Inc.

Description: A reusable brattice for use in coal mining. Quick and inexpensive to install - seals better than present stoppings. Improved air seal saves power and improves safety.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 28, 1977 Award Date: Sep 20, 1979

Received by DOE from NBS: Dec 19, 1978 Final Report Accepted:

Status: Award Award Amount: $62,664

Development Stage: Prototype Development

Summary: A grant in the amount of $62,664 has been awarded to fabricate 25 prototype brattices and install them in Peabody Coal Co. Eagle #2 underground coal mine (Southern IL). Data will be collected over a 2 1/2 year period to measure the effects of natural subsidence on the performances of the brattices.

DOE # 92 DOE Coordinator G. K. Ellis Contact: John L Carroll

OERI # 1160 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Tri-Water, A Combination Air Conditioning and Fire Protection System for a Building.

Patent # 3 939 914

Inventor: John L Carroll
State/Country: OR
Company:

Description: Utilizes common plumbing system with water serving as heat source/sink for heat pumps as well as sprinkler system.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 22, 1976 Decision Date:

Received by DOE from NBS: Dec 28, 1978 Final Report Accepted:

Status: Analysis I

Development Stage: Limited Production/Marketing

Summary: Recommendation under consideration by DOE

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          Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report
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        DOE  #     93     DOE Coordinator  G. K. Ellis        Contact: Edward M Shelander
                                                                       P.O. Box #803
        OERI #   1300     DOE Program Off: CS                          Brunswick             GA  31520
                                                                       912/265-6464
        Category: Industrial Processes

        Title: Shelander-Burrows Process for Recovery of Metallic Values
               from Smelter Emissions

        Inventor:  Edward M Shelander                                  Patent # 3 849 121
        State/Country:  GA
        Company:

        Description:  A solution/precipitation process for recovery of zinc, lead, and copper from
                      the baghouse dust collected from smelter emissions.



        Significant Dates, Status and  Summary of Developments:

          Form 1019 Rec'd by NBS:     Aug  9, 1976         Award Date:            Mar 29, 1980

          Received by DOE from NBS:   Jan 24, 1979      Final Report Accepted:

          Status:  Award                              Award Amount:   $87,742

          Development Stage: Prototype Test

        Summary:       A grant in the amount of $87,742 has been awarded to provide an engineering
                       and economic analysis of the subject process.



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        DOE  #     94     DOE Coordinator  J. Aellen          Contact: William M FioRito

        OERI #   3079     DOE Program Off: CS

        Category: Industrial Processes

        Title: Lantz Converter


        Inventor:  William M FioRito                                   Patent # 2 906 122
        State/Country:  CA
        Company:   Pan American Resources, Inc.

        Description:  Unit for pyrolyzing municipal refuse that uses natural gas to bring converter
                      up to pyrolyzing temperature and then switches to pyrolytic gases to maintain
                      the process.



        Significant Dates, Status and  Summary of Developments:

          Form 1019 Rec'd by NBS:     Mar  2, 1978      Decision Date:

          Received by DOE from NBS:   Jan 30, 1979      Final Report Accepted:

          Status:  Analysis II

          Development Stage: Concept Development

        Summary:       After meeting with the invention coordinator, inventor is modifying proposal.



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        Date:  Mar 31, 1981                                                        Page:  47
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DOE # 68 DOE Coordinator D. G. Nelle Contact: Val G Bertoia

OERI # 3879 DOE Program Off: CS

Category: Other Natural Sources

Title: Omni-Horizontal Axis-Wind Turbine

Inventor: Val G Bertoia
State/Country: PA
Company: Bertoia Studio

Description: A low cost, self starting, horizontal axis wind turbine with novel blade orientation. Operation is relatively insensitive to wind direction.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 10, 1978 Decision Date:

Received by DOE from NBS: Jan 30, 1979 Final Report Accepted: Aug 6, 1980

Status: No DOE Support

Development Stage: Concept Development

Summary: Inventor requested project be terminated for his convenience. Preliminary DOE review suggested that project would not be economically justifiable.

DOE # . 98 DOE Coordinator J. Aellen

Contact: Floyd R Anderson
Vast Research Company
Seven Tiffany Lane
Bella Vista AR 72712
501/855-9202

OERI # 1889 DOE Program Off: CS

Category: Combustion Engines & Components

Title: Leavell, Vibrationless, Low Noise, High Efficiency, Pneumatic Percussion Tools and Air Compressor Systems

Patent # 3 266 581 & Others

Inventor: Floyd R Anderson
State/Country: AR
Company: Vast Research Company

Description: Pneumatic tools (paving breaker, etc.) reconfigured to obtain additional energy from high temperature compressed air. High temperature and low pressure requires larger displacement and therefore overall size to achieve same output power.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 28, 1977 Completion Date: Sep 12, 1979

Received by DOE from NBS: Feb 25, 1979 Final Report Accepted: Jul 28, 1980

Status: Complete Award Amount: $76,675

Development Stage:

Summary: A grant in the amount of $76,675 was awarded to design, build, and test six pneumatic tools. Independent test evaluation by a third party did analyze energy input and output, rate of work, noise and vibration. Results have been compared with performance of conventional tools.

DOE # 97 DOE Coordinator: J. Aellen

OERI # 3679 DOE Program Off: CS

Category: Industrial Processes

Title: Water Drying System

Contact: James W McCord
Corpane Industries, Inc.
250 Production Court
Bluegrass Industrial Park
Louisville KY 40299
502/491-4433

Inventor: James W McCord
State/Country: KY
Company: Corpane Industries, Inc.

Patent Applied For

Description: A technique for removing wash water from manufactured parts by dipping parts into degreaser solvent and mechanically separating water by virtue of differences in liquid densities.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 9, 1976

Award Date: Sep 10, 1980

Received by DOE from NBS: Feb 28, 1979

Final Report Accepted:

Status: Award

Award Amount: $93,800

Development Stage: Engineering Design

Summary: An award in the amount of $53,800 has been granted to design and construct demonstration models of a system to dry water from metal parts.

DOE # 98 DOE Coordinator: G. K. Ellis

OERI # 3547 DOE Program Off: CS

Category: Industrial Processes

Contact: James L. Chill, President
Chillcast, Inc.
404 Executive Boulevard
Marion OH 43302
614/383-6337

Title: Process Development to Conserve Energy and Material---(in the manufacture of)---Bearings

Inventor: James L Chill
State/Country: OH
Company: Chillcast, Inc.

Patent Applied For

Description: A methodology for continuously casting a sheet of the desired bearing alloy, in the desired thickness, cutting it to the proper length, rolling it to the specified diameter, and welding it together.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 17, 1979

Award Date: Dec 31, 1979

Received by DOE from NBS: Mar 14, 1979

Final Report Accepted:

Status: Award

Award Amount: $123,994

Development Stage: Prototype Development

Summary: A $123,994 grant was awarded for the grantee to work with Battelle Memorial Institute to optimize the rolling-pass and heat treatment schedules, establish and compare the performance characteristics of the prototype bearings with those made by current methods, evaluate cylindrical bearings with and without a seam weld, and investigate performance of prototypes containing only 3% tin.

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DOE  #     99     DOE Coordinator  J. G. Wells         Contact: Robert Gordon, President
                                                                Struct. Comp Inc., Inc.
OERI #   4659     DOE Program Off: CS                           6344 N. Irwindale Avenue
                                                                Azusa                 CA  91702
Category: Transportation Systems, Vehicles & Components         213/334-8221

Title: Light Weight Composite Trailer Tubes


Inventor:  Oscar Weingart
State/Country:  CA
Company:   Structural Composites Industries, Inc.

Description:  A design and manufacturing method for manufacture of composite pressure
              vessels employed in highway transport of gaseous fuel.



Significant Dates, Status and  Summary of Developments:

  Form 1019 Rec'd by NBS:     Jun  5, 1978         Award Date:             Jan 14, 1980

  Received by DOE from NBS:   Mar 30, 1979      Final Report Accepted:

  Status:  Award                              Award Amount:   $96,000

  Development Stage: Engineering Design

 Summary:      A grant in the amount of $96,000 has been awarded to design, fabricate, and
               test a large scale model of a new light-weight composite trailer tube for
               highway transportation of compressed gasses.  The three phase program will be
               completed in one year.
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DOE  #    100     DOE Coordinator  J. Aellen           Contact: Michael F Zinn
                                                                Bio-Energy Systems, Inc.
OERI #   3336     DOE Program Off: CS                           Mountaindale Road
                                                                Spring Glen           NY  12483
Category: Direct Solar                                          914/434-7858

Title: Solaroll


Inventor:  Michael F Zinn
State/Country:  NY
Company:   Bio-Energy Systems, Inc.

Description:  Flat plate solar collector for hot water and building heating systems.
              Collector is extrusion of ethylene-propylene-diamine rubber.



Significant Dates, Status and  Summary of Developments:

  Form 1019 Rec'd by NBS:     Dec  5, 1977         Award Date:             Mar 28, 1980

  Received by DOE from NBS:   Mar 30, 1979      Final Report Accepted:   Jul 18, 1979

  Status:  Award          ✓                   Award Amount:  $110,390

  Development Stage: Limited Production/Marketing

 Summary:      A grant in the amount of $110,390 has been awarded to generate, analyze,
               collate and assemble information in a form usable to others in the trade;
               construct, maintain, operate and test for different applications; to provide
               necessary material and labor to cooperate in the testing of Solaroll.
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DOE # 101 DOE Coordinator D.A.Craig Contact: Shared M Dave

OERI # 2114 DOE Program Off: CS

Category: Combustion Engines & Components

Title: Controlled Combustion Engine

Inventor: Shared M Dave Patent # 3 792 381
State/Country: MI
Company:

Description: A modified intake valve for spark ignition engines. Creates increased turbulence at low throttle settings to allow lean burning mixtures.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 28, 1977 Decision Date:

Received by DOE from NBS: Apr 20, 1979 Final Report Accepted:

Status: Procurement

Development Stage: Concept Development

Summary: The invention coordinator and inventor have agreed on scope of work for a grant.

DOE # 102 DOE Coordinator G. K. Ellis

OERI # 3205 DOE Program Off: ER

Contact: Frank C Bernhard
11936 Claychester Drive
St. Louis MO 63131
314/922-3484

Category: Buildings, Structures & Components

Title: Method of Burning Residual Fuel Oil in Distillate Fuel Oil Burners

Inventor: Frank C Bernhard Patent # 3 977 823
State/Country: MO
Company:

Description: The invention is a method to convert standard distillate fuel oil burners to residual fuel oil, which is accomplished by heating that portion of the combustion air used to atomize the fuel oil.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 19, 1977 Award Date: Feb 21, 1980

Received by DOE from NBS: Apr 24, 1979 Final Report Accepted:

Status: Award Award Amount: $43,550

Development Stage: Concept Development

Summary: A grant in the amount of $43,550 was awarded to design and build a packaged, self-contained fuel oil burning test stand that can burn residual fuel oil in any low-pressure, atomizing fuel oil burner.

DOE # 103 DOE Coordinator D. G. Wells
OERI # 1446 DOE Program Off: CS
Category: Buildings, Structures & Components

Contact: Edwin E Eckberg
Ecklus R & D Vacuum Lab Inc
5504 Currier Road
Boise ID 83705
208/342-7442

Title: Low Voltage Ionic Fluorescent Light Bulb

Inventor: Edwin E Eckberg
State/Country: ID
Company: Ecklus R & D Vacuum Laboratory, Inc.

Patent # 3 447 098 & Others

Description: Fluorescent light bulb built on Edison base. Excited by array of gas discharge tubes. Uniform output, high efficiency, and long life are claimed.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 17, 1976 Award Date: Mar 12, 1980

Received by DOE from NBS: Apr 30, 1979 Final Report Accepted:

Status: Award Award Amount: $73,554

Development Stage: Engineering Design

Summary: A grant in the amount of $73,554 was awarded to design, develop, fabricate and test a series of one, two and four-bulb configuration low-voltage fluorescent ionic light bulbs. The one-bulb version will be developed to a point suitable for semi-automatic machine production.

DOE # 104 DOE Coordinator G. K. Ellis
OERI # 2186 DOE Program Off: ER
Category: Miscellaneous

Contact: Eskil L Karlsen
4634 State Street
Erie PA 16508
814/868-1121

Title: Low Continuous Energy Mass Separation System

Inventor: Eskil L Karlsen
State/Country: PA
Company:

Patent Applied For

Description: The invention is a combination of any two or all three separation techniques involving chromatography, electrophoresis, and centrifugation (common in all combinations) to provide a low-energy continuous separation of chemical species or different isotopes, either in the gas phase or liquid phase.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 11, 1977 Award Date: Feb 26, 1980

Received by DOE from NBS: Apr 30, 1979 Final Report Accepted:

Status: Award ✓ Award Amount: $83,015

Development Stage: Laboratory Test

Summary: A grant in the amount of $83,015 has been awarded to build and test two laboratory models, for the purpose of optimizing the variables and assessing performance including the economics.

DOE # 105 DOE Coordinator J. Aellen Contact: Allen D Zumbrunnen

OERI # 2467 DOE Program Off: CS

Category: Industrial Processes

Title: High Frequency Furnace

Inventor: Allen D Zumbrunnen Patent # 4 133 969
State/Country: UT
Company:

Description: Furnace for the melting of reactive metals and semi-conductors which must be obtained in high purity form. It employs high frequency heating in a manner that allows the metal being melted to form its own crucible.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 24, 1977 Decision Date:

Received by DOE from NBS: Apr 30, 1979 Final Report Accepted:

Status: Analysis II

Development Stage: Concept Development

Summary: DOE unable to reach agreement with the inventor for proposed work plan.

DOE # 106 DOE Coordinator D. G. Mello Contact: James L Ramer

OERI # 2753 DOE Program Off: CS

Category: Miscellaneous

Title: Deep Shaft Hydro-Electric Power

Inventor: James L Ramer
State/Country: WI
Company:

Description: A proposal to investigate the use of underground salt domes/caves as pumped storage of water for production of peak demand electricity.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 30, 1977 Decision Date:

Received by DOE from NBS: May 10, 1979 Final Report Accepted: Jul 18, 1979

Status: No DOE Support

Development Stage: Concept Definition

Summary: Material submitted described a concept, but was not an invention. The concept related several well known ideas and proposed to unite them into one vast experiment. Feasibility of this concept was not well enough established to convince DOE to act.

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          DOE  #    107     DOE Coordinator  J.Aellen         Contact: Ping-Wha Lin

          OERI #   1416     DOE Program Off: CS

          Category: Industrial Processes

          Title: Waste Products Reclamation Process

          Inventor:  Ping-Wha Lin                              Patent # 3 861 930 & Others
          State/Country:  NY
          Company:

          Description:  This is a process for desulfurizing combustion gases, with a by-product
                        "Linfans" which is claimed to have economic uses as a 1) construction
                        material, 2) reagent for treating waste water, and 3) agent to react with
                        sulphur dioxide in stack gas scrubbing processes.


          Significant Dates, Status and  Summary of Developments:

            Form 1019 Rec'd by NBS:     Sep  9, 1976      Decision Date:

            Received by DOE from NBS:   May 31, 1979      Final Report Accepted:

            Status:  Analysis I

            Development Stage: Laboratory Test

          Summary:      Recommendation is under consideration by DOE.


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          DOE  #    108     DOE Coordinator  G. K. Ellis      Contact: Paul J Cromwell, President
                                                                       Cromwell Metals, Inc.
          OERI #   4680     DOE Program Off: CS                        1895 Sheridan Drive
                                                                       Buffalo              NY  14223
          Category: Industrial Processes

          Title: Processing Recovery of Aluminum

          Inventor:  Paul J Cromwell                           Patent # 4 126 673
          State/Country:  NY
          Company:   Cromwell Metals Inc.

          Description:  The invention is a mechanical process, operated at room temperature, for
                        separating aluminum metal from the dross.


          Significant Dates, Status and  Summary of Developments:

            Form 1019 Rec'd by NBS:     Dec 27, 1978        Award Date:            Jun 11, 1980

            Received by DOE from NBS:   May 31, 1979      Final Report Accepted:

            Status:  Award      ✓                      Award Amount:  $158,029

            Development Stage: Prototype Test

          Summary:      A grant in the amount of $158,029 has been awarded to develop and optimize the
                        complete design of a practical and economic production facility.


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DOE # 109 DOE Coordinator G. K. Ellis
OERI # 3221 DOE Program Off: CS
Category: Miscellaneous

Contact: H. W. Kennick
Clark Meat Science Lab
Oregon State University
Corvallis OR 97331
503/754-3675

Title: Hydrostatic Meat Tenderizer

Inventor: H. W. Kennick
State/Country: OR
Company: Clark Meat Science Lab.

Description: The invention is a method for tenderizing low-grade, grass fed beef by subjecting the boned meat to a hydrostatic pressure of over 15,000 psi for several minutes.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 11, 1978 Award Date: Jun 24, 1980

Received by DOE from NBS: Jun 19, 1979 Final Report Accepted:

Status: Award Award Amount: $50,000

Development Stage: Prototype Test

Summary: A grant in the amount of $80,000 has been awarded to investigate and develop a feasible commercial process.

DOE # 110 DOE Coordinator D. G. Welle
OERI # 3425 DOE Program Off: CS
Category: Other Natural Sources

Contact: Karl H. Bergey
Route #1, Box #151B
Norman OK 73069
405/325-7241

Title: Improved Windpower Generating System

Inventor: Karl H. Bergey
State/Country: OK
Company: Bergey Windpower Company

Patent Applied For

Description: Self regulating, two-part windmill rotor with inner part for low speed wind and outer part for high speed wind.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 19, 1978 Award Date: Aug 27, 1980

Received by DOE from NBS: Jun 29, 1979 Final Report Accepted:

Status: Award Award Amount: $74,875

Development Stage: Prototype Development

Summary: A one-year grant in the amount of $75,875 has been awarded for the development of an analytical program to characterize the operation of the Bergey windmill, design and test the prototype, and perform an economic analysis of the benefits of the design

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DOE # 111 DOE Coordinator D. G. Welle Contact: John C. Haspert
P.O. Box #1252
OERI # 3688 DOE Program Off: FE Arcadia CA 91006

Category: Fossil Fuels

Title: Haspert Mining System

Inventor: John C Haspert Patent # 4 062 594
State/Country: CA
Company: Underground Systems

Description: The invention is intended for developing rectangular openings for mineral development. It is a mechanical apparatus that cuts linear grooves in rock using drag bits and then breaks the rock between the grooves primarily in the tension mode. Potential applications are in oil shale, rock and possibly coal.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 27, 1978 Award Date: Mar 27, 1980

Received by DOE from NBS: Jun 29, 1979 Final Report Accepted:

Status: Award Award Amount: $125,000

Development Stage: Working Model

Summary: A $125,000 grant was awarded to provide a complete set of preliminary design drawings for a prototype machine for "driving" a drift for the mining of oil shale and coal. The cutter produces uniformly sized material at lower costs than present methods.

DOE # 112 DOE Coordinator D.R.Craig Contact: Paul Zanoni, President

OERI # 548 DOE Program Off: CS

Category: Fossil Fuels

Title: Pump

Inventor: Paul Zanoni Patent # 3 314 236
State/Country: WA
Company: Boulder Engineering, Inc.

Description: A conventional steam injector to serve as both feedwater pump and direct contact feedwater heater in conventional steam power plants.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 29, 1975 Decision Date:

Received by DOE from NBS: Jul 20, 1979 Final Report Accepted:

Status: Decision Phase

Development Stage: Concept Development

Summary: A proposal has been received from the inventor and is being evaluated.

DOE # 113 DOE Coordinator D.R.Craig Contact: Henry J Wallace

OERI # 3865 DOE Program Off: CS

Category: Industrial Processes

Title: Wallace Mold Additive System

Inventor: Henry J Wallace Patent # 3 871 058 & Others
State/Country: PA
Company:

Description: A device and method for feeding small pieces of metal scrap of known composition and at a fixed rate into a mold, while molten metal is being poured.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 20, 1978 Decision Date:

Received by DOE from NBS: Jul 31, 1979 Final Report Accepted: Feb 24, 1981

Status: No DOE Support

Development Stage: Prototype Development

Summary: The Proposal has been reviewed by two engineers in the steel-producing program office at DOE. The high probability of contamination along with the questionable feasibility doesn't point to a clear potential for success. Based on these reviews a decision has been made not to support this invention.

DOE # 114 DOE Coordinator D.R.Craig Contact: Mario Bruno

OERI # 3863 DOE Program Off: CS

Category: Transportation Systems, Vehicles & Components

Title: New Energy-Saving Tire for Motor Vehicles

Inventor: Renato Menzini
State/Country: Milan, I
Company: ECO Tires Company

Description: An automobile tire of innovative design intended to reduce rolling friction below that of equivalent radial tires. Special rims are required.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 20, 1978 Decision Date:

Received by DOE from NBS: Jul 31, 1979 Final Report Accepted:

Status: Analysis I

Development Stage: Prototype Development

Summary: Recommendation under consideration by DOE.

DOE # 115 DOE Coordinator D. G. Mello
OERI # 1188 DOE Program Off: CS

Contact: Clyde C Phillips
Rural Route #2
Box #148-G, Angola Beach
Lewes DE 19971
302/945-9893

Category: Miscellaneous

Title: Refrigeration System

Inventor: Clyde C Phillips
State/Country: DE
Company: Phillips Engineering Company

Patent # 3 783 629

Description: Device to be installed between the compressor and the air cooled condenser in a small refrigeration unit. It consists of a dryer-filter heat exchanger, a venturi-ejector, and connecting piping.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 2, 1976 Completion Date: Dec 7, 1979

Received by DOE from NBS: Jul 31, 1979 Final Report Accepted:

Status: Complete Award Amount: $6,910

Development Stage: Laboratory Test

Summary: The grantee installed his device in one large-capacity, and one small-capacity commercially available air conditioners and shipped them to an independent testing laboratory where the change in performance was documented. No energy savings were apparent.

DOE # 116 DOE Coordinator G. K. Ellis
OERI # 2946 DOE Program Off: CS

Contact: Roy J Walkert

Category: Industrial Processes

Title: Model 5000 ASEPAK System

Inventor: Roy J Walkert
State/Country: OH
Company: General Films, Inc.

Patent # 3 813 845 & Others

Description: The inventions are for new methods for fabricating and aseptically filling sterile plastic bags with certain classes of food materials that have been previously sterilized by ultra-high temperature processes for very short periods of time.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 4, 1977 Decision Date:

Received by DOE from NBS: Aug 30, 1979 Final Report Accepted:

Status: No DOE Support

Development Stage: Prototype Development

Summary: Unable to identify suitable scope of work which was both agreeable to the inventor and supportable by DOE.

DOE # 117 DOE Coordinator J. Kellen Contact: George E Mattson
361 Moraine Street
CERI # 2189 DOE Program Off: CS Brockton MA 02401
617/588-9819

Category: Direct Solar

Title: "Solarspan" Prism Tree

Inventor: John Mattson Patent Applied For
State/Country: MA
Company:

Description: An all-plastic, black liquid, solar collector with provisions for freeze and overheat protection. Plastic can be molded to give good structural properties with thin sections.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 28, 1977 Award Date: Sep 30, 1980

Received by DOE from NBS: Sep 20, 1979 Final Report Accepted:

Status: Award Award Amount: $98,700

Development Stage: Prototype Test

Summary: An award in the amount of $98,700 has been awarded to design, test and construct low cost plastic solar water heating panels.

DOE # 118 DOE Coordinator R.Bell Contact: Roderick L Smith

CERI # 3876 DOE Program Off: CS

Category: Industrial Processes

Title: Energy Adaptive Control of Precision Grinding

Inventor: Roderick L Smith Patent # 3 653 855
State/Country: IL
Company: Energy Adaptive Grinding, Inc.

Description: The invention consists of an otherwise conventional, universal, external cylindrical grinder retrofitted with a computer control to save energy in removing metal.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 24, 1979 Decision Date:

Received by DOE from NBS: Sep 27, 1979 Final Report Accepted:

Status: Decision Phase

Development Stage: Limited Production/Marketing

Summary: A proposal has been received from the inventor and is being evaluated.

DOE # 119   DOE Coordinator D.R.Craig   Contact: Otis W Smith

OERI # 4656   DOE Program Off: CS

Category: Industrial Processes

Title: Air Ratio Controller (AERTROL)

Inventor: Eldon L Asher
State/Country: FL
Company: PROTROL, Inc.

Description: A controller that controls the running time of a blower in proportion to the rate of flow of liquid in forced aeration type sewage plants: developed specifically to serve many small package treatment plants with liquid flow of less than 100,000 gallons per day.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 5, 1978   Decision Date:

Received by DOE from NBS: Sep 28, 1979   Final Report Accepted:

Status: Procurement

Development Stage: Concept Development

Summary: Invention coordinator and inventor have agreed to scope of work for a grant.

DOE # 120   DOE Coordinator R. Ball   Contact: Robert Zartarian

OERI # 4562   DOE Program Off: CS

Category: Miscellaneous

Title: Vapor Heat Transfer Commercial Griddle

Inventor: Robert Zartarian   Patent Applied For
State/Country: MA
Company: Food Facilities Design

Description: A griddle for restaurants with its surface heated by vapor condensation. This vapor is boiled with electric elements in a sump below the griddle surface. Vapor and condensed liquid are hermetically sealed.

Significant Dates, Status and Summary of Developments:

Form 1319 Rec'd by NBS: Nov 2, 1978   Decision Date:

Received by DOE from NBS: Oct 17, 1979   Final Report Accepted:

Status: Decision Phase

Development Stage: Limited Production/Marketing

Summary: Proposal has been received and is being considered by DOE. General Counsel is now reviewing proposal because inventor is undergoing bankruptcy.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

DOE # 121 DOE Coordinator J. Aellen Contact: James B Whitmore

OERI # 4843 DOE Program Off: CS

Category: Direct Solar

Title: Solar Space Heating for both Retrofit and New Construction

Inventor: James B Whitmore
State/Country: MI
Company: Sunway Heatings Systems, Inc.

Description: Passive solar collector using air as the transfer fluid. Designed for vertical south wall of a structure.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 9, 1979 Decision Date:

Received by DOE from NBS: Oct 25, 1979 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: Inventor is requesting assistance in developing strategy for marketing.

DOE # 122 DOE Coordinator J. Aellen Contact: Michael D Leshner
Fuel Injection Dev. Corp.
110 Harding Avenue
Bellmawr NJ 08030

OERI # 4038 DOE Program Off: CS

Category: Combustion Engines & Components

Title: Lean Limit Controller

Inventor: Michael D Leshner Patent # 4 015 572
State/Country: NJ
Company: Fuel Injection Development Corp.

Description: A device to apply adaptive control to air-fuel metering in internal combustion engines.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 12, 1979 Award Date: Sep 24, 1980

Received by DOE from NBS: Nov 23, 1979 Final Report Accepted:

Status: Award Award Amount: $99,500

Development Stage: Prototype Test

Summary: An award in the amount of $99,500 has been granted to design and test a lean limit control device for an internal combustion engine.

DOE # 123 DOE Coordinator G. K. Ellis

OERI # 4573 DOE Program Off:

Category: Industrial Processes

Contact: J. Paul Pemsler, President
Castle Technology Corp.
P. O. Box 4403
Lexington MA 02133
617/861-7056

Title: Comminution of Ores by a Low-Energy Process

Inventor: J Paul Pemsler
State/Country: MA
Company: Castle Technology Corp.

Description: Heating with microwaves to differentially expand and fracture the sulphur containing elements of ore and porphory rock. Intended as a preliminary stage in the processing of ore before the grinding stage.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 6, 1978 Award Date: Sep 25, 1980

Received by DOE from NBS: Nov 29, 1979 Final Report Accepted:

Status: Award Award Amount: $90,394

Development Stage: Laboratory Test

Summary: A grant in the amount of $90,394 has been awarded to explore the technical feasibility and determine the energy input for the process.

DOE # 124 DOE Coordinator R. Bell Contact: Charlton Sadler

OERI # 4282 DOE Program Off: CS

Category: Direct Solar

Title: Solar Collector

Inventor: Charlton Sadler Patent # 4 170 983 & Others
State/Country: FL
Company:

Description: This solar collector is a two foot square module constructed entirely of a non-porous ceramic which has been fired at high temperatures so that it is vitrified.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 30, 1979 Decision Date:

Received by DOE from NBS: Nov 30, 1979 Final Report Accepted:

Status: Analysis II

Development Stage: Working Model

Summary: Awaiting a revised statement of work and cost proposal.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 125 DOE Coordinator G.K.Ellis

OERI # 707 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: The Turbulator Burner System

Contact: Frank W Bailey
P.O. Box 494
Fourth Avenue
Haskell NJ 07420
201/481-1225

Inventor: Frank W Bailey
State/Country: NJ
Company: Bailey Burners, Inc.

Patent Applied For

Description: Invention is a stirred heat exchanger (SHE) consisting of a heat exchanger with an annular cross section surrounding a region where the higher temperature fluid flows axially. Blades attached to an axial shaft stir the fluid at the surface of convective heat transfer. Offers possibility of enhanced heat transfer using dirty gasses.

Significant Dates, Status and Summary of Developments:

Form 1319 Rec'd by NBS: Feb 11, 1976 Award Date: Sep 29, 1980

Received by DOE from NBS: Dec 31, 1979 Final Report Accepted:

Status: Award Award Amount: $75,000

Development Stage: Prototype Test

Summary: A grant in the amount of $75,000 has been awarded to design, build, test and evaluate both an externally and an internally stirred heat exchanger.

DOE # 126 DOE Coordinator J. Aellen

OERI # 4970 DOE Program Off: CS

Category: Industrial Processes

Title: Vaclaim

Contact: Karl D Scheffer
121 Governor Drive
Scotia NY 12302
518/399-0016

Inventor: Karl D Scheffer
State/Country: NY
Company:

Description: A system for use in metal casting foundries. Reclaims heat from metal castings and energy from the binder in no-bake molds. Eliminates smoke and fumes from the foundry.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 19, 1979 Award Date: Apr 1, 1981

Received by DOE from NBS: Dec 31, 1979 Final Report Accepted:

Status: Award Award Amount: $97,734

Development Stage: Laboratory Test

Summary: A award of $97,734 was given for fabrication and testing heat recovery in vacuum metal casting process using no-bake molds.

DOE # 127 DOE Coordinator G. K. Ellis Contact: William R Bowen

OERI # 5003 DOE Program Off: FE

Category: Fossil Fuels

Title: Process and Apparatus to Produce Crude Oil from Tar Sands

Inventor: J D Seader
State/Country: UT
Company:

Description: Two vessel fluidized bed system connected by heat pipes to transfer heat between the upper pyrolizer vessel, and the lower combustor vessel in which char residue is burned. Clean sand comes out in the tailings and a usable grade of synthetic crude oil out the overhead.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 26, 1979 Decision Date:

Received by DOE from NBS: Dec 31, 1979 Final Report Accepted:

Status: Analysis I

Development Stage: Laboratory Test

Summary: Recommendation under consideration by DOE.

DOE # 128 DOE Coordinator G. K. Ellis Contact: William R Bowen

OERI # 5004 DOE Program Off: RA

Category: Fossil Fuels

Title: Continuous Distillation Apparatus and Method

Inventor: J D Seader Patent Applied For
State/Country: UT
Company:

Description: New design for distilling column where the rectifying and stripping sections are side by side and heat pipes transfer heat from the rectifying to the stripping section.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 26, 1979 Decision Date:

Received by DOE from NBS: Dec 31, 1979 Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: Recommendation under consideration by DOE.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 129 DOE Coordinator J. Aellen Contact: James E Kessler
Box #8115
Leawood KS 66208
913/722-0504
OERI # 4007 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: Super U System - Snap Strap

Inventor: James E Kessler Patent # 4 069 636
State/Country: KS
Company: CIS International, Inc.

Description: Super U-Snap strap insulation system which is an innovative application technique.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 24, 1978 Award Date: Nov 28, 1980

Received by DOE from NBS: Jan 31, 1980 Final Report Accepted:

Status: Award Award Amount: $84,642

Development Stage: Prototype Development

Summary: A grant of $84,642 has been awarded to test market of the Super U System and installers.

DOE # 130 DOE Coordinator R.Bell Contact: Arnold R Post

OERI # 6389 DOE Program Off: IS

Category: Buildings, Structures & Components

Title: Furnace Input Capacity Trimming Switch

Inventor: Arnold R Post
State/Country: PA
Company:

Description: A simple inexpensive device for gas and oil furnaces to reduce the flue gas heat loss. During morning startup, when the room thermostat is calling for heat, the device will cycle the furnace on and off to minimize flue gas heat loss.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 11, 1978 Decision Date:

Received by DOE from NBS: Feb 26, 1980 Final Report Accepted:

Status: Analysis I

Development Stage: Laboratory Test

Summary: Awaiting preliminary proposal. Inventor has been informed that he has until August 30, 1981 to submit a preliminary proposal or his invention will no longer be considered by the DOE.

DOE # 131 DOE Coordinator J. Aellen

OERI # 5110 DOE Program Off: CS

Category: Combustion Engines & Components

Title: Valve Deactuator for Internal Combustion Engines

Contact: M. John Beck
BKM, Inc.
1065 Bay Blvd., Suite C
Chula Vista CA 92011
714/425-3510

Inventor: Edgar R Jordan
State/Country: MI
Company: LPK, Inc.

Patent # 4 114 580

Description: A retrofit device that can provide variable displacement operation on existing gasoline engines by one cylinder at a time deactuating.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 1, 1979 Award Date: Sep 25, 1980

Received by DOE from NBS: Feb 29, 1980 Final Report Accepted:

Status: Award Award Amount: $65,972

Development Stage: Prototype Development

Summary: An award in the amount of $65,972 has been granted to develop and test a valve deactivator for internal combustion engines.

DOE # 132 DOE Coordinator D.G.Mello

OERI # 3045 DOE Program Off: IS

Category: Industrial Processes

Title: Process for Reclaiming and Upgrading Thin-Walled Malleable Waste Material

Contact: Michael Knezevich

Inventor: Michael Knezevich
State/Country: IN
Company: M. K. Metals, Inc.

Patent # 4 119 453

Description: Is a system for mechanically pelletizing ferrous and non-ferrous metals and some plastics, grading according to size and then separation according to density by conventional gravity techniques.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 22, 1977 Decision Date:

Received by DOE from NBS: Mar 25, 1980 Final Report Accepted:

Status: Analysis I

Development Stage: Limited Production/Marketing

Summary: Recommendation under consideration by DOE.

DOE # 133 DOE Coordinator G.K.Ellis Contact: James V Enright

OERI # 4641 DOE Program Off: IS

Category: Transportation Systems, Vehicles & Components

Title: AUTOTHERM Car Comfort System

Inventor: F J Perhats Patent Applied For
State/Country: IL
Company: Autotherm, Inc.

Description: It is an auxiliary coolant circulator for an automobile which will provide heat to the vehicle operator for a period of time without requiring the engine to idle.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 27, 1978 Decision Date:

Received by DOE from NBS: Mar 26, 1980 Final Report Accepted:

Status: Procurement

Development Stage: Limited Production/Marketing

Summary: Invention coordinator and inventor have agreed to scope of work for a grant.

DOE # 136 DOE Coordinator G.K.Ellis Contact: John C Rupert
1511 Grantham Street
OERI # 5239 DOE Program Off: IS Saint Paul MN 55108

Category: Buildings, Structures & Components

Title: Expanded Polystyrene Bead Insulation System

Inventor: John C Rupert Patent Applied For
State/Country: MN
Company: Rupert Insulation Products, Inc.

Description: It is a means for retro-insulating housing walls.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 30, 1979 Award Date: Sep 26, 1980

Received by DOE from NBS: Mar 31, 1980 Final Report Accepted:

Status: Award Award Amount: $80,944

Development Stage: Limited Production/Marketing

Summary: A grant in the amount of $80,944 has been awarded to select an adhesive/flame retardant, test it at an independent laboratory, develop the blower system, develop a business plan, and demonstrate the technology.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 138 DOE Coordinator R. Bell Contact: M Hossein Khorsand

OERI # 5216 DOE Program Off: IS

Category: Direct Solar

Title: Point Focus Parabolic Solar Collector

Inventor: M Hossein Khorsand
State/Country: ID
Company:

Description: It is a lightweight parabolic solar collector design which used prestressed structural members and cables to achieve high rigidity at a low cost.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 29, 1979 Decision Date:

Received by DOE from NBS: Apr 30, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Working Model

Summary: Statement of work has been received and is under final evaluation by DOE.

DOE # 136 DOE Coordinator J. Aellen Contact: Albert S Richardson, Jr.

OERI # 3885 DOE Program Off: CS

Category: Miscellaneous

Title: Windamper

Inventor: Albert S Richardson, Jr. Patent # 3 440 328
State/Country: WA
Company: Richardson Products, Inc.

Description: Wind damper for high voltage electric transmission line to prevent galloping in wind and ice storms

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 25, 1978 Decision Date:

Received by DOE from NBS: May 5, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Limited Production/Marketing

Summary: DOE is exploring options for assistance to the inventor.

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       Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report
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          DOE  #    137     DOE Coordinator  J. Aellen          Contact: H Roy Weber

          OERI #   5130     DOE Program Off: CS

          Category: Industrial Processes

          Title: A Portable Pollution Free Automobile Incinerator


          Inventor:  H Roy Weber                                       Patent Applied For
          State/Country:  MI
          Company:   Kallus Auto Wreckers

          Description:  Portable automobile incinerator




          Significant Dates, Status and  Summary of Developments:

            Form 1019 Rec'd by NBS:     May 17, 1979      Decision Date:

            Received by DOE from NBS:   May  8, 1980      Final Report Accepted:

            Status:  Procurement

            Development Stage: Prototype Development

          Summary:      Invention coordinator and inventor have agreed to scope of work for a grant.


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          DOE  #    138     DOE Coordinator  J. Aellen          Contact: Gerald R Seeman

          OERI #   1994     DOE Program Off: CS

          Category: Buildings, Structures & Components

          Title: Phantom Tube


          Inventor:  Gerald R Seeman                                   Patent # 3 956 668
          State/Country:  CA
          Company:   Developmental Sciences, Inc.

          Description:  Phantom tube is a non light emitting, low energy device to be paired with a
                        fluorescent tube in rapid or instant start fixtures.



          Significant Dates, Status and  Summary of Developments:

            Form 1019 Rec'd by NBS:     Mar 28, 1977      Decision Date:

            Received by DOE from NBS:   May 29, 1980      Final Report Accepted:

            Status:  Analysis II

            Development Stage: Limited Production/Marketing

          Summary:      Recommendation under DOE evaluation.


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DOE # 139 DOE Coordinator D.R.Craig Contact: Louis L Marton

OERI # 3487 DOE Program Off: CS

Category: Miscellaneous

Title: Transformer With Heat Dissipator

Inventor: Louis L Marton Patent # 3 680 239 & Others
State/Country: CA
Company:

Description: An improved method for cooling dry-type transformers, thereby increasing their efficiency without increasing their weight and cost.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 16, 1978 Decision Date:

Received by DOE from NBS: May 29, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: Inventor does not seek grant money but wishes us to exert legislative influence to require more efficient transformers in general. It is not clear whether or not this service can be provided.

DOE # 140 DOE Coordinator G.K.Ellis Contact: W E Mattson

OERI # 3830 DOE Program Off: CS

Category: Industrial Processes

Title: Counter Flow Dual Tube Heat Exchanger

Inventor: W E Mattson
State/Country: MN
Company: VETCON

Description: It is a simple plastic heat exchanger to preheat ventilating air for poultry or livestock barns.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 6, 1978 Decision Date:

Received by DOE from NBS: Jun 20, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Concept Definition

Summary: A preliminary proposal has been received from the inventor and is being evaluated.

DOE # 141   DOE Coordinator R. Bell   Contact: Samuel Shiber

OERI # 3673   DOE Program Off: CS

Category: Transportation Systems, Vehicles & Components

Title: New Hydrostatic Transmission

Inventor: Samuel Shiber   Patent Applied For
State/Country: IL
Company:

Description: It is a continuously variable hydraulic positive displacement transmission with lockup, overdrive and regenerative braking for automotive and other vehicular use.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 6, 1978   Decision Date:

Received by DOE from NBS: Jun 23, 1980   Final Report Accepted:

Status: Analysis II

Development Stage: Concept Development

Summary: Recommendation under DOE Evaluation.

DOE # 142   DOE Coordinator J. Aellen   Contact: Anatol Michelson

OERI # 5022   DOE Program Off: CS

Category: Industrial Processes

Title: Process for Heatless Production of Hollow Items

Inventor: Anatol Michelson   Patent Applied For
State/Country: FL
Company:

Description: A metal casting method for hollow parts

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 24, 1979   Decision Date:

Received by DOE from NBS: Jun 26, 1980   Final Report Accepted:

Status: Procurement

Development Stage: Prototype Test

Summary: Invention coordinator and inventor have agreed on a scope of work for a grant.

DOE # 143 DOE Coordinator J Aellen Contact: Robert R Hermann

OERI # 5888 DOE Program Off: CS

Category: Fossil Fuels

Title: Oil Well Pump Jack

Inventor: Robert A Clay Patent Applied For
State/Country: CA
Company:

Description: A new design pump that would replace the conventional beam pumps in pumping oil wells. It utilizes longer strokes than generally used by the beam pumps and has slower rates of acceleration/deceleration, reducing the power required to overcome the inertia of the sucker rods and other moving parts.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 19, 1979 Decision Date:

Received by DOE from NBS: Jun 27, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Prototype Test

Summary: Awaiting revised statement of work and cost proposal.

DOE # 144 DOE Coordinator J. Aellen Contact: Robert C Saunders, Jr.

OERI # 5852 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: SeaCirc Space Circulation Fan

Inventor: Robert C Saunders, Jr.
State/Country: MD
Company:

Description: The invention is a different type of ceiling fan designed for improved circulation and mixing of air throughout an air conditioned room. The increased air velocity allows the perception of comfort at higher temperatures and humidities.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Oct 9, 1979 Decision Date:

Received by DOE from NBS: Jul 23, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Concept Development

Summary: Statement of work has been received and is under final evaluation by DOE.

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         Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report
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      DOE #    148     DOE Coordinator  J. Aellen          Contact: Robert E Solomon

      OERI #   6213    DOE Program Off: IS

      Category: Direct Solar

      Title: Solar Conversion by Concentration Cells with Hydrides


      Inventor:  Robert E Solomon
      State/Country:  PA
      Company:

      Description:  The invention is a hydrogen concentration cell which converts solar energy to
                    electricity by using heat to generate the gas pressure to drive the cell.  (It
                    is an electrochemical heat engine with sunlight furnishing the heat.)



      Significant Dates, Status and  Summary of Developments:

        Form 1019 Rec'd by NBS:     Dec 26, 1979      Decision Date:

        Received by DOE from NBS:   Jul 29, 1980      Final Report Accepted:

        Status:  Procurement

        Development Stage: Concept Development

      Summary:       Invention coordinator and inventor have agreed to scope of work for a grant.



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      DOE  #    146     DOE Coordinator  R.Bell             Contact: Sylvain J Pirson

      OERI #   4796     DOE Program Off: IS

      Category: Fossil Fuels

      Title: Line Integral Method of Magneto-Electric Exploration


      Inventor:  Sylvain J Pirson                               Patent # 3 943 436
      State/Country:  TX
      Company:   Synergy Company

      Description:  A method of exploring for gas and oil deposits by plotting the intensity and
                    polarities of local perturbations in the earths magnetic field. These
                    perturbations are caused by naturally occuring electrotelluric (ET) currents
                    associated with the oil and gas.


      Significant Dates, Status and  Summary of Developments:

        Form 1019 Rec'd by NBS:     Jan 25, 1979      Decision Date:

        Received by DOE from NBS:   Jul 30, 1980      Final Report Accepted:

        Status:  Analysis II

        Development Stage: Limited Production/Marketing

      Summary:       A preliminary proposal has been received and is being evaluated by DOE.



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      Date:  Mar 31, 1981                                              Page:  73
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DOE # 147 DOE Coordinator J. Aellen Contact: A. D. Barrett, VP

OERI # 5092 DOE Program Off: IS

Category: Transportation Systems, Vehicles & Components

Title: Railroad Switch Heater

Inventor: Henry Kemp, Jr. Patent Applied For
State/Country: CT
Company: Heat Trace Division, Multistress, Inc.

Description: The invention is an electric resistance heater for attachment to railroad switches. The heater can be activated to prevent ice and snow from clogging the area where the railroad switch is closed or opened.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 6, 1979 Decision Date:

Received by DOE from NBS: Jul 31, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: Recommendation under evaluation at DOE.

DOE # 148 DOE Coordinator J. Aellen Contact: Leonard A Duval

OERI # 5418 DOE Program Off: IS

Category: Industrial Processes

Title: Reclamation of Oil and High-Grade Iron Concentrates from Steel Mill Wastes

Inventor: Leonard A Duval Patent # 3 844 943
State/Country: OH
Company:

Description: The invention is a process for steel mills to use in order to recover the energy value of the oil and mill scale from the mill scale produced in rolling mill operations.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 22, 1979 Decision Date:

Received by DOE from NBS: Aug 15, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Working Model

Summary: A preliminary proposal has been received and is being evaluated by DOE.

DOE # 149 DOE Coordinator D.R.Craig

OERI # 9810 DOE Program Off: IS

Category: Buildings, Structures & Components

Contact: Ogden H Hammond
Count Digital, Inc.
P.O. Box 9119
Cambridge MA 02142
617/729-9229

Title: SCOTCH - (Simple, Cost-Effective, Optimum Temperature Control for Housing)

Inventor: Ogden H Hammond
State/Country: MA
Company: Count Digital, Ltd.

Description: A system to retrofit residential and other steam heating systems to allow zone heating.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 6, 1979 Award Date: Jan 28, 1981

Received by DOE from NBS: Aug 18, 1980 Final Report Accepted:

Status: Award Award Amount: $91,962

Development Stage: Concept Development

Summary: A grant of $91,962 was awarded to design, build and test prototype installations in a number of residences in the Boston area where steam heated homes are numerous and winters severe.

DOE # 150 DOE Coordinator G.K.Ellis Contact: Edward W Widlak

OERI # 7141 DOE Program Off:

Category: Industrial Processes

Title: The Use of Solid Waste Material from a Lubricating Oil and/or Vegetable Oil Refining Operation.

Inventor: Edward W Widlak
State/Country: LA
Company:

Description: The invention involves the use of solid waste material from a lubricating oil and/or vegetable oil refining operation being used as a raw material for a Portland Cement plant.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jun 16, 1980 Decision Date:

Received by DOE from NBS: Sep 30, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Production Engineering

Summary: Statement of work has been received and is under final evaluation by DOE.

DOE # 181 DOE Coordinator J.Aellen Contact: Yao Tzu Li

OERI # 3494 DOE Program Off:

Category: Buildings, Structures & Components

Title: Film Type Storm Window

Inventor: Yao Tzu Li
State/Country: MA
Company:

Description: A plastic film type of storm window that is tensioned at the corners and sealed on the perimeter to produce a wrinkle free and air tight membrane for window insulation.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 30, 1979 Decision Date:

Received by DOE from NBS: Sep 30, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Concept Development

Summary: Statement of work has been received and is under final review by DOE.

DOE # 182 DOE Coordinator R.Bell Contact: David S Majbrzak

OERI # 6439 DOE Program Off:

Category: Transportation Systems, Vehicles & Components

Title: Vehicle Exhaust Gas Warm-up System

Inventor: David S Majbrzak
State/Country: MD
Company:

Description: An accelerated warm-up system for an internal combustion engine which uses the hot exhaust gasses to heat the cooling water. Engine cooling water is ducted to a heat exchanger/muffler in the exhaust system during the warm-up period.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 12, 1980 Decision Date:

Received by DOE from NBS: Sep 30, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Prototype Development

Summary: Statement of work has been received and is under final evaluation by DOE.

DOE # 153 DOE Coordinator R.Bell Contact: Carl E Pearl

OERI # 5853 DOE Program Off:

Category: Miscellaneous

Title: A New Equipment Design Concept for Storage of Hot Foods

Inventor: Carl E Pearl
State/Country: CA
Company:

Description: A series of food handlidg systems designed to reduce heat loss/gain during storage or transport. The basic concept is that of including a heat storage material with the food enclosed in an insulated container to allow the food to stay warm/cool longer.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 10, 1979 Decision Date:

Received by DOE from NBS: Sep 30, 1980 Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: Recommendation under consideration by DOE.

DOE # 154 DOE Coordinator J.Aellen Contact: Forrest E Chancellor

OERI # 5750 DOE Program Off:

Category: Fossil Fuels

Title: Rotating Horsehead for Pumping Units

Inventor: Forrest E Chancellor Patent # 4 121 471
State/Country: CA
Company:

Description: An ellipsoidal head for an oil well pump beam unit used in sucker-rod pumping. The ellipsoidal head increases the strokes of the sucker-rod over that of the conventional "horse" head and thus causes an increase in flow.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Sep 7, 1979 Decision Date:

Received by DOE from NBS: Oct 29, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Limited Production/Marketing

Summary: Statement of work has been received and is under final evaluation by DOE.

DOE # 155 DOE Coordinator J.Aellen Contact: James W Cleary

OERI # 7292 DOE Program Off:

Category: Fossil Fuels

Title: Slip Mining

Inventor: James W Cleary Patent # 4 059 309 & Others
State/Country: WA
Company:

Description: A method of surface mining coal that involves skidding a series of overburden blocks off the coal. The blocks are buoyantly supported, stabilized and displaced by a dense mud slurry. Slabs of coal uncovered by block movement are floated to the surface of the dense mud and recovered from the surface of the mud filled pit.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 23, 1980 Decision Date:

Received by DOE from NBS: Oct 31, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Concept Development

Summary: Preliminary proposal has been received and is being evaluated by DOE.

DOE # 656 DOE Coordinator R.Bell Contact: James J Dolan

OERI # 5375 DOE Program Off:

Category: Industrial Processes

Title: Direct-Current Electrical Heat-Treatment of Continuous Metal Sheets in a Protective Atmosphere.

Inventor: James J Dolan Patent # 4 154 432 & Others
State/Country: CT
Company: Valjim Corporation

Description: A New Application of electrical conduction for the continuous heat treatment of rolled steel strip that uses less energy than conventional methods.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jul 3, 1979 Decision Date:

Received by DOE from NBS: Oct 31, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: Preliminary proposal has been received and is being reviewed by DOE.

DOE # 157 DOE Coordinator R.Bell Contact: Albert L McQuillen, Jr

OERI # 5968 DOE Program Off:

Category: Industrial Processes

Title: Magnaseal Method and Means for Sealing Steel Ingot Casting
Molds to Stools.

Inventor: Albert L McQuillen, Jr Patent # 3 937 397
State/Country: PA
Company: 33 Hundred, Inc.

Description: A Means of sealing steel ingot casting molds to stools by use of fine metallic particles and an electromagnetic field to emplace the particles.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 1, 1979 Decision Date:

Received by DOE from NBS: Oct 31, 1980 Final Report Accepted:

Status: Procurement

Development Stage: Prototype Test

Summary: Invention coordinator and inventor have agreed to scope of work for a grant.

DOE # 158 DOE Coordinator D.R.Craig Contact: Paul F Pugh

OERI # 2049 DOE Program Off:

Category: Miscellaneous

Title: Energy Conservative Electric Cable System

Inventor: Paul F Pugh Patent Applied For
State/Country: CA
Company:

Description: A low-loss shielded power cable using a naturally cooled sodium conductor and a pressurized gas insulator.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 13, 1977 Decision Date:

Received by DOE from NBS: Oct 31, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: Received preliminary statement of work, awaiting a revised proposal.

DOE # 159 DOE Coordinator J.Aellen Contact: William D Gramling

OERI # 5380 DOE Program Off:

Category: Fossil Fuels

Title: Non-Tubing Type Lift Device. Described as the NTT Rabbit

Inventor: William D Gramling Patent # 4 113 010 & Others
State/Country: MO
Company: Gramling Engineering

Description: A Gas powered lift device designed to collect oil from low producing (or non-producing) wells. It is a piston device which is lowered inside the oil well casing into the liquid. A Pressure operated valve closes. the gas pressure below increases. and the device rises lifting the fluid trapped above.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 7, 1979 Decision Date:

Received by DOE from NBS: Nov 25, 1980 Final Report Accepted:

Status: Decision Phase

Development Stage: Production & Marketing

Summary: Proposal is under final DOE review.

DOE # 168 DOE Coordinator D.R.Craig Contact: Leon Lazare

OERI # 6900 DOE Program Off:

Category: Buildings, Structures & Components

Title: High Efficiency Absorption Refrigeration Cycle

Inventor: Leon Lazare
State/Country: CT
Company: The Puree Company

Description: An improved absorption refrigeration cycle employing a novel combination of absorbent and refrigerant fluids. Both a simple stage and two-stage cycle system are presented.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 22, 1980 Decision Date:

Received by DOE from NBS: Nov 25, 1980 Final Report Accepted:

Status: Procurement

Development Stage: Engineering Design

Summary: Invention coordinator and inventor have agreed to scope of work for a grant.

DOE # 161 DOE Coordinator R.Bell Contact: Anthony A duPont

OERI # 854 DOE Program Off:

Category: Fossil Fuels

Title: duPont Connell Energy Coal Gasification Process

Inventor: Anthony A duPont Patent Applied For
State/Country: CA
Company: duPont Connell Energy

Description: A method of making Btu gas from coal is described. A key feature is control of retort heat fluxes.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Mar 31, 1976 Decision Date:

Received by DOE from NBS: Nov 28, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Working Model

Summary: A preliminary statement of work has been received and is being evaluated by OCE. Awaiting decision from program office on whether they'll support the invention or not.

DOE # 162 DOE Coordinator D.R.Craig Contact: Lemuel Leslie Ply

OERI # 6992 DOE Program Off:

Category: Industrial Processes

Title: Tubular Pneumatic Conveyor Pipeline

Inventor: Lemuel Leslie Ply Patent # 4 116 491
State/Country: TX
Company:

Description: A pneumatic tubular conveyor pipeline for transporting dry granular materials such as coal, barite or cement over long distances. The pipeline has an outer impervious pipe and an inner porous pipe radially spaced.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 23, 1980 Decision Date:

Received by DOE from NBS: Nov 28, 1980 Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: Inventor is seeking cooperation of a laboratory which can test his conveyor prior to submitting a proposal.

DOE # 103 DOE Coordinator D.R.Craig Contact: Dennis D Howard

OERI # 6831 DOE Program Off:

Category: Buildings, Structures & Components

Title: Thermotropic Plastic Films

Inventor: Dennis D Howard
State/Country: PA
Company: Hughson Chemicals

Description: A thermotropic plastic film which can be formulated to become opaque above a particular temperature. When sealed between two layers of glass it could serve as window panes for greenhouses or other solar heated structures.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 15, 1980 Decision Date:

Received by DOE from NBS: Dec 4, 1980 Final Report Accepted:

Status: Procurement

Development Stage: Engineering Design

Summary: Invention coordinator and inventor have agreed to scope of work for a grant.

DOE # 104 DOE Coordinator D.R.Craig Contact: Robert R Larsen

OERI # 6433 DOE Program Off:

Category: Transportation Systems, Vehicles & Components

Title: Elastomer Energy Recovery Elements and Vehicle Component Applications

Inventor: Robert R Larsen
State/Country: MD
Company: Elastomer Energy Recovery Inc

Description: A regenerative braking device, for a small urban automobile, that stores energy during downhill operation for additional acceleration and power when needed with a minimum of fuel consumption. Energy is mechanically stored by an elastomeric storage device.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 12, 1979 Decision Date:

Received by DOE from NBS: Dec 4, 1980 Final Report Accepted:

Status: Procurement

Development Stage: Concept Development

Summary: Invention coordinator and inventor have agreed to scope of work for a grant.

DOE # 165 DOE Coordinator G.K.Ellis Contact: Wu-Chi Chen

OERI # 6995 DOE Program Off:

Category: Fossil Fuels

Title: Process for Recovering Hydrogen and Elemental Sulfur from
Hydrogen Sulfide and/or Mercaptans-Containing Hydrogen

Inventor: Wu-Chi Chen Patent # 4 066 739
State/Country: TX
Company:

Description: A new process for recovering hydrogen and elemental-sulfur from hydrogen sulfide using iodine slurry

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: May 16, 1980 Decision Date:

Received by DOE from NBS: Dec 29, 1980 Final Report Accepted:

Status: Analysis I

Development Stage: Concept Development

Summary: Recommendation under consideration by DOE.

DOE # 166 DOE Coordinator D.R.Craig Contact: Robert F Evans

OERI # 4656 DOE Program Off: FOSSIL

Category: Fossil Fuels

Title: Borehole Angle Control

Inventor: Robert F Evans
State/Country: TX
Company:

Description: A modified oil well drill bit which can correct the course of the borehole as the hole is being drilled. It selectively injects cuttings to one side of the drill bit to provide a wedging action between the bit and the borehole.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Nov 27, 1979 Decision Date:

Received by DOE from NBS: Dec 29, 1980 Final Report Accepted:

Status: Analysis II

Development Stage: Concept Development

Summary: A preliminary proposal has been received and is being evaluated by DOE.

DOE # 167 DOE Coordinator D.R.Craig Contact: Edward B Connors

OERI # 6483 DOE Program Off:

Category: Industrial Processes

Title: Vaned Pipe for Pipeline Transport of Solids

Inventor: Edward B Connors
State/Country: ID
Company:

Description: A slurry pipeline with helical vanes to maintain a rotating motion in the slurry to hold the solids in suspension in the laminar flow range, thus increasing the range of flow rates at which solids can be transported without settling.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Feb 25, 1980 Decision Date:

Received by DOE from NBS: Jan 19, 1981 Final Report Accepted:

Status: Analysis II

Development Stage: Engineering Design

Summary: A preliminary proposal has been received and is being evaluated by DOE.

DOE # 168 DOE Coordinator G.K.Ellis Contact: Spencer Kim Mews

OERI # 6783 DOE Program Off: CS

Category: Buildings, Structures & Components

Title: The Hot Water Saver

Inventor: Spencer Kim Mews Patent Applied For
State/Country: WA
Company: Alternative Energy Resources Inc

Description: Modifications to a residential hot water system so that hot water trapped in the pipes between the water-heater and the point of use is returned back to the water heater thus reducing heat loss and water consumption.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 7, 1980 Decision Date:

Received by DOE from NBS: Jan 28, 1981 Final Report Accepted:

Status: Analysis II

Development Stage: Limited Production/Marketing

Summary: Preliminary proposal has been received and is under evaluation by DOE.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 169 DOE Coordinator D.R.Craig Contact: B O Combs

OERI # 6239 DOE Program Off: CS

Category: Industrial Processes

Title: MIRAFOUNT

Inventor: Mervin W Martin Patent # 3 745 977
State/Country: MO
Company: MIRACO Manufacturing

Description: A cattle waterer which is functional in the coldest climate without the use of an immersed electric or gas heater. It consists of a heavily insulated tank with a floating, insulated cover and a float valve assembly.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 27, 1979 Decision Date:

Received by DOE from NBS: Jan 30, 1981 Final Report Accepted:

Status: Analysis I

Development Stage: Limited Production/Marketing

Summary: Recommendation under consideration by DOE.

DOE # 170 DOE Coordinator J.Aellen Contact: Thomas R Mee

OERI # 5622 DOE Program Off: CS

Category: Industrial Processes

Title: Fog System - Low Energy Freeze Protection for Agriculture

Inventor: Thomas R Mee Patent # 4 039 144 & Others
State/Country: CA
Company: Mee Industries Inc

Description: A low energy-consuming agricultural freeze protection system using a non-polluting man-made water fog to cover crops and prevent heat loss and freeze damage. The fog system is designed to use significantly less energy than oil-burning agricultural heaters.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 22, 1979 Decision Date:

Received by DOE from NBS: Jan 30, 1981 Final Report Accepted:

Status: Analysis I

Development Stage: Prototype Development

Summary: Recommendation under consideration by DOE.

DOE # 171 DOE Coordinator D.R.Craig Contact: Karakian Bedrosian

OERI # 6950 DOE Program Off:

Category: Industrial Processes

Title: A Method of Preserving Fruits and Vegetables without Refrigeration

Inventor: Karakian Bedrosian Patent # 4 079 152
State/Country: NJ
Company:

Description: A Method for preserving fruits and vegetables without refrigeration by using controlled atmosphere packages to keep oxygen levels low and the water vapor and carbon dioxide levels at desired optimums.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Apr 28, 1980 Decision Date:

Received by DOE from NBS: Feb 23, 1981 Final Report Accepted:

Status: Decision Phase

Development Stage: Limited Production/Marketing

Summary: Proposal has been received and is under final consideration by DOE.

DOE # 172 DOE Coordinator Contact: Edward A Griswold

OERI # 4255 DOE Program Off:

Category: Industrial Processes

Title: GEM Electrostatic Filtration System

Inventor: Edward A Griswold Patent # 3 591 528 & Others
State/Country: CA
Company: Special Equipment Company

Description: An electrostatic filter for removing suspended particles from fluids such as hydraulic fluids, liquid fuels, engine lubricants and waste oil.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Aug 3, 1978 Decision Date:

Received by DOE from NBS: Feb 26, 1981 Final Report Accepted:

Status: Analysis I

Development Stage: Prototype Test

Summary: Recommendation under consideration by DOE.

Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report

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DOE # 173 DOE Coordinator R.Bell Contact: Bill Burley

OERI # 6277 DOE Program Off:

Category: Buildings, Structures & Components

Title: Thermal Ice Cap

Inventor: Bill Burley
State/Country: PA
Company:

Description: An insulating blanket to reduce refrigeration loads in ice skating rinks during periods of non-use, combined with an advanced method of applying and removing the 17,000 sq. ft of thermal.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Jan 7, 1980 Decision Date:

Received by DOE from NBS: Feb 26, 1981 Final Report Accepted:

Status: Analysis I

Development Stage: Working Model

Summary: Recommendation under consideration by DOE.

DOE # 174 DOE Coordinator J.Aellen Contact: Gene Plattner

OERI # 6244 DOE Program Off:

Category: Buildings, Structures & Components

Title: Skate on Plastic Ice Skating System

Inventor: E C Nathaniel Patent # 4 330 720
State/Country: NC
Company: Skate-On, Inc.

Description: A non-refrigerated plastic skating surface to replace energy intensive ice skating surfaces.

Significant Dates, Status and Summary of Developments:

Form 1019 Rec'd by NBS: Dec 31, 1979 Decision Date:

Received by DOE from NBS: Mar 5, 1981 Final Report Accepted:

Status: Analysis I

Development Stage: Limited Production/Marketing

Summary: Recommendation under consideration by DOE.

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          Inventions Recommended for DOE Consideration by NBS' OERI - A Brief Status Report
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          DOE #    175     DOE Coordinator  J.Aellen            Contact: C W Seward

          OERI #   6931    DOE Program Off:

          Category: Industrial Processes

          Title: A Low-Energy Carpet Backing System


          Inventor:  Don M Acres                                        Patent Applied For
          State/Country:  GA
          Company:   DASM, Inc.

          Description:  A low energy carpet backing system which uses a hot-melt thermoplastic
                        coating.  The hot-melt coating replaces the present latex adhesive coating
                        which locks the tufts or stitches into the primary backing fabric.



          Significant Dates, Status and  Summary of Developments:

            Form 1019 Rec'd by NBS:      May  5, 1980      Decision Date:

            Received by DOE from NBS:   Mar 26, 1981      Final Report Accepted:

            Status:  Analysis I

            Development Stage: Prototype Development

          Summary:      Recommendation under consideration by DOE.


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Mr. **Gore**. Thank you very much. Mr. DeGeorge? If we followed protocol, we would have called on you first, and I apologize for that.

Mr. **DeGeorge**. That is no problem, Mr. Gore.

As you know, I have testified previously before you and other members of the committee. I prefer that the actual administrators of the programs handle most of the details. I will make a few comments about administrative policy at the end, but these two gentlemen have been associated with the program a great deal more than I, and I think they deserve to talk to the substance of the program. So I will defer.

Mr. **Mello**. Thank you, Mr. Chairman.

I know most of these people personally. I have known the people on my left and right for some time in the program. I think what I have heard today is going to be of more interest to the committee and everyone in here if we give more time to the panelists.

I will be glad to answer any questions on this program. I have been with it almost from the beginning, but I do not think I will add anything to it at this time, with your permission.

Mr. **Gore**. Mr. DeGeorge?

Mr. **DeGeorge**. Mr. Chairman, I think that there are a couple of philosophical comments that are worth making. I know there is considerable debate on the investments in R. & D. that this administration has decided to make and where it has decided to target its dollars. And within the conservation and renewable area, including solar, there have been substantial reductions, as you are well aware, from other committee hearings.

I want to point out that this program has not been touched, either in the 1981 revisions, rescission requests, or in the 1982 budget. It has not been increased; it is not growing. It has not been reduced.

I also want to point out DOE's view of the program. From the $5 million appropriation per se, we do support and pay for the NBS staff. They have no appropriation of their own in this area.

That evaluation investment at the beginning of this program presents a considerable dilemma. To evaluate thousands of proposals—many are a relatively unsophisticated—is a very heavy investment. Approximately half of the total amount appropriated is spent in this evaluation process at NBS.

It causes one to ask the question. Is this program too open? When we get thousands of applications and if 1 percent comes out at the bottom, is this efficient management? I have serious questions whather we are not putting too much in at the beginning of the process. If we spend half of the money evaluating that we award, it presents questions in my mind as to what the proper mix should be.

I do not want to create a sense that I am anything other than an unqualified endorser of the program. However, I just have some mental reservations about a program for $5 million in which we spend 2 or 2½ million to evaluate, to get to 1 percent of the people who apply. We ought to ask ourselves questions about whether we ought to make the procedure more formal at the front end. We should find some way to deal with it so that some higher percentages of that money, perhaps, will go to the people who actually do the work.

From my view, we do the evaluation of the award, but we do not actually do the creative work. This is why I would ask how we might maximize that end of it, given a specific amount of money.

[The prepared statement of Mr. DeGeorge follows:]

STATEMENT OF

FRANK D. DEGEORGE

DEPUTY ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY

U.S. DEPARTMENT OF ENERGY

Mr. Gore, and members of the Subcommittee on Investigations and Oversight:

Thank you for the invitation to discuss the NBS/DOE Energy-Related Inventions Program.

The Energy-Related Inventions Program was established in the Federal Non-Nuclear Energy Research and Development Act of 1974, (Public Law 93-577, section 14).

The Program is designed to encourage and support independent inventors and small businessmen in the development of energy-saving technologies. It provides for evaluation of inventions by the Office of Energy-Related Inventions (OERI) of the National Bureau of Standards (NBS), Department of Commerce.

The Department of Energy (DOE) then considers granting Federal support, usually in the form of a grant award or other assistance, to inventors with newly-developed technologies to facilitate eventual market acceptance of their products.

DOE plans to award 36 grants in FY 1981. In the past six months, the Inventions Division has issued grants to 14 inventors. The average value of these grants is expected to be $85,000 per grant.

While the primary method of DOE support is a grant award, other types of assistance are also provided. These may include technical assistance and administrative assistance.

DOE technical assistance may include the following:

- Test and evaluation of the invention at a Government Laboratory or by contract to a private testing laboratory;

- DOE program office contract for further development of the invention.

Additional types of DOE non-financial assistance have taken the form of administrative assistance in the following areas:

- Referrals to other agencies in cases where the invention is not appropriate for the Energy-Related Inventions Program;
- DOE sponsorship at regional and national technology exhibits;
- Assistance in obtaining GSA "new product" contracts;
- SBA consideration to assist in obtaining a loan or in seeking venture capital;
- Assisting the inventor in assessing the opportunities offered by private investors; and
- Development of a business or financial plan.

Most of the inventors contacted about their experiences said their product would not have been successful without the DOE grant and/or the other assistance they received. In several cases, the NBS letter of recommendation proved to be invaluable in securing loans or venture capital support.

National Innovation Workshops (NIW) -- Initiated and administered by NBS for DOE in 1980, this conference series provides practical guidance and information to inventors and innovative small businesses throughout the nation. The general theme of these conferences is encouragement of innovation in energy-related technologies. The conferences feature workshops with topics including: developing ideas into inventions, patenting and protection, licensing and selling inventions, and new business start-up. The attendees, numbering from 250 to 500, receive materials that identify sources of consultation, financial assistance, and technical and socio-economic information. In 1980, NIWs were held in San Francisco, Boston, Atlanta, Philadelphia and Arlington, Texas. In February and March 1981, workshops were held in Denver and Minneapolis. Indianapolis and Seattle NIWs are scheduled for July 17-18 and August 21-22, respectively.

Significant Inventions

Some examples of inventions which have recently received DOE grant awards and that are worthy of mention due to their potential for energy savings are:

- "Mine Brattice," James Allen Bagby, Bagby Brattices, Inc., Greenville, Kentucky.

  This device is a reusable brattice, which is a partition used to form ventilation passages in coal mines. The Bagby Brattice is claimed to be quick and inexpensive to install and seals better than present stoppings. If widely adopted, an improved air seal can save the equivalent of several thousand tons of coal per year in reduced requirements for ventilation energy requirements. In addition, maintenance personnel normally assigned to the task are made available for the primary task of extracting coal, thereby increasing the productivity of the mine.

  The Department of Energy has awarded a grant of $62,664 to provide for the fabrication and installation of 25 prototype brattices in a Southern Illinois underground coal mine. The grant provides for collection of data over a 2 1/2 year period to measure the effects of natural subsidence on the performance of the brattices. Subsequent performance tests indicate that the device is already performing beyond all expectations and the tests have been terminated. The device has now been put into full-time use in this mine, and it will soon be installed in other mines as well.

- "Leavell, Vibrationless, Low Noise, High Efficiency, Pneumatic Percussion Tools and Air Compressor System," Floyd R. Anderson, Vast Research Company, Bella Vista, Arkansas.

  The invention is a design concept for pneumatic tools, in which heated air can be utilized by the tool directly after compression without the aftercooling characteristic of conventional compressor-tool systems. Higher temperature inlet and lower pressure exhaust increases energy efficiency over conventional-design tools.

  The Department of Energy awarded a grant of $76,675 to design, build, and test six pneumatic tools. The results of independent tests to analyze energy input and output, rate of work, and noise and vibration, compare favorably with the performance of conventional tools. The potential for energy savings could be up to 70 percent for a specific application.

- "Air-Cooled Compressor Heat Recovery and Heat Circulation System Plus Ambient Air Filter and Air Cleaner for Same Compressor," Kenneth A. Stofen, Ken Stofen Associates, Racine, Wisconsin.

  The inventor has developed an environmental barrier or envelope (Ecology Package) to contain the heat exchange surfaces and air intake for compressed air generation systems.

  The Department of Energy awarded a grant of $53,000 to design and build ecology cabinets: to procure, assemble, operate, test and gather data on the operations of the air-cooled compressor and ecology package. Air-cooled compressors have the advantage over water-cooled compressors in that they 1) eliminate requirements for cooling water, 2) can use heated air for space heat, and 3) require no sewage connection.

  At the 1981 9th Annual World Fair for Technology Exchange in Atlanta, Georgia, this system was awarded first place in the Industry Division for "Significant Achievement in Technological Development."

- "Processing Recovery of Aluminum," Paul J. Cromwell, Cromwell Metals, Inc., Buffalo, New York.

  This invention is a mechanical process, operated at room temperature, for separating aluminum metal from dross, the waste material formed on the surface of molten metal. Since aluminum has a high energy requirement for its initial production, significant energy savings result. There are other processes for recovering aluminum from the dross, but the Cromwell process appears to recover about 90 percent more aluminum from a given amount of dross than the next best process.

  The Department of Energy awarded a grant of $158,029 to develop and to optimize the complete design of a practical and economic production facility.

DOE is fostering an environment where these inventors, with the technology and persistence to succeed, can develop their ideas and find acceptance in the marketplace.

Mr. Chairman, this concludes my presentation.

Mr. GORE. Thank you very much. Mr. Reed, let's start with you this time.

Mr. REED. The first thing, where do you get your figures for the ratio of half as much money being spent for evaluation? Where do you get your figures about half as much money being spent for evaluation purposes as is being awarded?

Mr. MELLO. From the money that is appropriated from the program, approximately $5.8 million, about $2.4 million of it goes to the National Bureau of Standards for all of the work they have to do.

The cost per invention, Mr. Lewett can give you exactly. In addition to the evaluations, we at DOE have given Mr. Lewett other tasks which we think enhance the value of the program to inventors. Perhaps you are aware of the National Invention Workshops and others. So those costs come from that.

Mr. REED. But how many total dollars have been awarded?

Mr. MELLO. We have awarded over $7 million now to inventors.

Mr. REED. And the program has been in existence roughly 6 years and a few months. How many dollars have been used to administer that program during that 6 years?

Mr. MELLO. In the first year, there was no money at all for the program. The programmatic offices at DOE paid for it themselves from their own, and we had appropriations that were incrementally larger—$2.5, 3 million, $3½ or $4.

Mr. REED. Since it's inception?

Mr. MELLO. Yes, sir; in 1 year, we had a peak of $6.4 million. It was an extraordinary $1 million extra given to us by Congress to reduce the backlog of inventions that had come to us that we had not been able to address.

Mr. GORE. If I could interrupt and focus your question, what is the total amount during the time you have been in existence? What is the total amount that has been spent in the program on administration, overhead?

Mr. MELLO. Well, I don't have that number accumulated.

Mr. GORE. Give it to us by years, then.

Mr. MELLO. 1978, a total cost of $3 million; in 1979—this number is incorrect. That should have been—with the extra dollars, should have been $6.2 million.

Mr. GORE. In 1979?

Mr. MELLO. Yes; in 1980, it was $6.4 million.

Mr. DEGEORGE. Mr. Chairman, if I might——

Mr. GORE. That is $19 million—$19 million for the program and $6 million awarded to the innovators.

Go ahead, Mr. Reed.

Mr. REED. I think you have pretty well gotten to the point that I was trying to get an answer on. And I do not believe we have gotten one yet.

Mr. DEGEORGE. I'll give you a specific answer, to the best of my knowledge and understanding. The number of DOE inventions program professional staff has never exceeded four people. It has basically never spent millions of dollars on anything that you and I would agree with. In terms of evaluation, it has been tens of thousands of dollars; it has not spent millions of dollars to administer the program.

Substantively, the money is going to these two places, and I would say 95 percent of the money is going to these two places—to NBS for evaluation for centers, and for grants. A very small percentage, less than 5 percent, and it may be closer to 1 or 2 percent—has been spent by DOE.

Now that, I think, is the information you are soliciting.

Mr. REED. I guess, though, you are not comprehending my question. What I really want to know is not any—a description of your accounting system. What I really want to know is whether they are DOE dollars or NBS dollars? How many total dollars have been spent during the 6-year program to administer it against the $7 million that has been awarded?

Mr. DEGEORGE. Then I will give you some off-the-top-of-the-head numbers. The total professional and nonprofessional DOE inventions program staff has averaged five. If we have spent $1 million in the 5 or 6 years in DOE or more than $1 million or 1½ million, I would be greatly surprised. I have no idea how much NBS has spent on their own administrative expense.

Mr. REED. That is surprising. It seems to me that those figures are somewhat basic for congressional purposes, and it seems to me, if I were the head of such an agency, I would want to know those to kind of do a self-evaluation.

Mr. DEGEORGE. I would be glad to provide them to the chairman and to you, Mr. Reed. There are 59 active programs in solar, conservation, and renewable programs, and I do not have those numbers off the top of my head.

[The information you require is under review, and we will submit an answer to you as soon as possible.]

Mr. **Gore**. That is the program that we're looking at today.

Mr. **DeGeorge**. I have seen the numbers in the last couple of days, Mr. Chairman. Mr. Mello, I am sure, and these two gentlemen can probably give you those numbers at this moment.

Mr. **Gore**. Let's have them.

Mr. **Lewett**. I would like to comment, if I may.

Mr. **Gore**. I would like the numbers, if you have them.

Mr. **Lewett**. I don't have the specifics. I think I have the NBS budget for the last 3 years, but I don't have the numbers back to 1976 at this point in time.

I would like to comment on them.

Mr. **Gore**. Do you have the numbers, Mr. Mello?

Mr. **Mello**. No, sir; I don't.

Mr. **Gore**. I have some numbers up here. If you all don't have any of your own, let me just read these into the record, and then we will invite you to supply additional data for the record.

The staff has put together a table entitled "NBS/DOE funding levels for the Energy Related Inventions Program." 1977, $2 million; 1978, $3 million; 1979, $4 million; 1980, $6,400,000; 1981, $5,600,000.

We have a breakdown for fiscal year 1981 of DOE salaries/overhead, $600,000; NBS salaries, $1 million; evaluation contracts, $500,000; computer expenses, $400,000; onsite contracts, $200,000; grants to technical societies, $175,000; library assistance, $225,000; grant moneys, $2,500,000.

Now if the overall grant figure is as you said, Mr. Mello, $6 million in the time since this program has been created, that would be $6 million out of $22 million, so the remaining 16—you would have $16 million overhead for $6 million of grants.

Mr. **Rabinow**. That is not overhead if there are evaluators who are evaluating, and when we pay outside consultants that is not overhead. You're saying that an evaluator who disapproves an idea is overhead. Overhead is a secretary, or telephone calls. But if you have a professional hired to evaluate, he is part of the expense of the evaluation. I cannot see that you can call that overhead. When an evaluator rejects, he works as hard as when he approves. His output is not only the approval of the 1 percent, as you suggest, but also the 99 percent disapproval.

Mr. **Gore**. Well, I'm not wedded to the word.

Mr. **Rabinow**. The direct cost of the development of the invention. If I hire a consultant to work for me privately to tell me how the invention should work or better, I could not call it overhead. But my lawyer expense and my legal expense, I would call overhead. I think you would agree that overhead is not direct evaluation.

Mr. **Reed**. My question had to do with administrative costs, and I am not willing to——

Mr. **Rabinow**. You call an evaluator an administrator?

Mr. **Reed**. My point is that the total cost of administering the program would appear to be roughly twice what they are awarding rather than the reverse, as the statement had previously been made.

Mr. Lewett. May I make a comment? I would like to make a correction on the costs you just read on the OERI operation. The one item, the computer cost of $200,000, that covers——

Mr. Gore. $400,000.

Mr. Lewett. Those were the figures I gave you last night—correct figure for the record is $200,000. That figure should cover not only computer operational costs but also travel, typewriter leasing, book and document purchases, and miscellaneous support costs. The total of $2.5 million is the OERI budget for this year.

Let me address Mr. Reed's question which is a very fundamental and very legitimate one, of how much we are spending to run the program versus how much we are providing in grants to recommended inventors.

Now remember first that the first two recommendations that we made out of the program were made back in February 1976, which is almost 2 years after the program started, although when we opened the doors there were some 300 inventions waiting for evaluation. It took us eventually—and these numbers are statistically sound—about 3 years to fill the pipeline, that is, set up an evaluation process and have it flowing so that recommendations were coming out monthly in a steady flow. It took DOE about 2 years to finally get their funding mechanism straight as to how they were going to fund the inventions that we were recommending to them.

I described the program earlier as a continuous flow operating process. Right now we are on a steady-state operating basis, but the startup period to get to that point took 3 to 4 years. So, much of the initial funding, the first million and a quarter that we received through fiscal years 1975 to 1976, could be considered administrative expense in that it went for initial process design and development, and other efforts that have not been repeated.

If you are looking at the operating costs now, you should look in terms of the statistics that we are currently generating, where we are spending say $1.1 million each year in direct evaluation costs and another $900,000 in support costs and then review those costs on the basis of an input rate of 200 inventions coming in for evaluation and three going out in recommendations each month. The figure of $600,000 per year is estimated as allocated to activities classified as supplemental; that is, not direct evaluation or support; see also "Comments for the Record" by G. P. Lewett.

Each of those three recommended inventions receives an average grant award of $80,000. That is $240,000 coming out per month in support money versus $2 million annual evaluation costs; $240,000 a month times 12 months is about $2.9 million annually, so that actual support funds provided to investors are greater than the evaluation costs. That is how operating costs for the program should be viewed.

Now DOE has initiated a formal program evaluation, as they are required to by law—to determine whether this program is worthwhile. This evaluation program now will attempt to establish a third piece necessary to complete the picture.

We are, as I say, on a steady-state operating basis, spending $2 million in evaluation costs to award about $2.9 million to support 36 inventions—three inventions a month. The third piece is the benefits, which together with the costs above will determine the effectiveness of the program. The benefits to be derived as a result of the program include not only those associated with successes of supported inventions but also those associated for example with evaluation reports provided to rejected inventors—say 2,364 per year, some positive, some negative.

Those measures of the benefits are the figures which DOE will arrive at, hopefully by the end of the year, under this formal program evaluation. So all of the figures are not in, and we want to be very careful on a program like this which is very important to inventors, that we do not present a distorted picture at this point.

I would like to leave it at that.

Mr. Reed. Mr. Lewett, I have to observe that your responses to simple questions which call for rather simple answers are somewhat like your correspondence. You tell me so much that I did not ask and do not care to know, while failing to deal with the questions that I have raised.

The next question I would really like to raise is, since this program, according to section 14 of Public Law 93-577, specifically relates to evaluating ideas with particular reference to energy savings or energy-producing ideas involving small inventors and so forth, now have you ever seen the Washington Post article—it was carried in several papers throughout the Nation—concerning energy-saving gizmos which might make oil sheiks tremble with laughter?

Mr. Lewett. I do not recall that particular one, but I have seen many newspaper articles on the program.

Mr. Reed. This one would appear to be a press release from your organization. It quotes you and several of your evaluators.

Mr. Lewett. The Department of Commerce as well as the Department of Energy has had formal press releases on the program. I do not think that is one. The press may quote my however; I do get interviewed quite often.

Mr. Reed. The thing that concerns me is, the whole thrust of the article is one of making light of the small inventors with which this organization was created to deal.

Mr. Lewett. Is this one from the Washington Post about a year and a half ago, 2 years ago?

Mr. Reed. August 19, 1979.

Mr. Lewett. Yes, I think I know the article now. I wrote a letter to the editor on that one, which was unfortunately not published, The letter was written because one of the thrusts of the program is to attempt to counteract the public image of the inventor as a "Rube Goldberg," and the article did present that image. I think Mr. Mason and yourself also should be well aware of some of the activities that the program is engaged in to counteract this image by supporting inventor organizations, for example.

That article was damaging to the program; there is no question about it. Since that particular article was written, I have referred the Washington Post—when they request information on the program—to our PR people, rather than opening up our doors to them as we did in helping them prepare that article. I know the article, and believe me, it went very much against the grain of myself and my office, with the thrust that it did take.

Mr. **Reed**. The quotes came from you and your evaluators, though?

Mr. **Lewett**. I don't think I was quoted properly in that article. I think—one of the statements that was made probably came from me, but I would have to review the article, see it over again. I would be glad to discuss it with you, but I do not remember the specifics at this point. All I can say is that it does not reflect our attitude on the independent inventor.

[Note.—The basic article was written by a Washington Post staff member, based on interviews with DOE and NBS program personnel, publications describing the program, and a tour of the facilities. It was published in the Post on August 17, 1979. The article distributed by Mr. Reed and discussed here is a version modified by the Washington Post wire service.]

Mr. **Gore**. Gentlemen, I am going to have to ask your indulgence. We have an amendment on the floor. I am going to have to recess the hearing for approximately 15 minutes, and I apologize to you.

I would like to get Mr. Lewett's letter to the editor for the record at this point, if possible. We will go back into session in about 15 minutes, and we want to continue this. This kind of vigorous exchange I think may lead to some enlightenment for the subcommittee.

[The information follows:]

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

August 23, 1979

Editor
Washington Post
1150 15th Street, N.W.
Washington, D.C. 20071

Dear Editor:

The article "Energy Savings Inventions: 5 of 11,000 Make It" in the August 17 Post was interesting but disappointing in its treatment of a program which is addressing two major national problems, energy and innovation. The headline "5 of 11,000" and later discussion are misleading in reporting the program's output. The 5 inventions for which support has been completed are being followed by about 100 others in various stages of processing.

The actual yield is consistent with similar inventions programs. For example, the program by the National Research Development Corporation of Great Britain--which counts the Hovercraft among the innovations submitted to it by an independent inventor--experiences approximately the same success rate. The yield may be better represented in terms of DOE funding for recommended inventions: $250,000 monthly to innovative small business to bring new energy technology and products to market.

The article's focus on fringe elements in the independent inventor population was also disturbing. The image of the independent inventor thus promulgated is damaging to efforts to increase use of this proven national resource of innovation.

Lastly, please note that the Office of Energy-Related Inventions and most of the people interviewed for the article are in the National Bureau of Standards, an agency of the Department of Commerce, not the Department of Energy. Our recommendations about promising inventions are forwarded directly to the Department of Energy, which then considers support for the inventors.

Sincerely,

George P. Lewett
Chief, Office of Energy-Related Inventions
National Bureau of Standards

Mr. **Gore**. We will come to order again, with the apologies from the subcommittee to all of our participants. Before going back to our panel of questioners, let me put this information in the record. The NSF program we heard about earlier was started in 1977. OERI was started in 1975. NSF has received 2,000 proposals. OERI has received 16,780. NSF has made 200 awards. OERI has made 39 awards. NSF has awarded to 11 percent of the proposals it has received. OERI, one-quarter of 1 percent. However, some are in process. And if all in process end up being funded, then it would represent 1.3 percent.

STAFFING LEVEL COMPARISON

NSF has two full-time persons—one secretary, one part-time student—and numerous part-time reviewers. DOE has four professional people full time; no secretary. NBS has five full-time evaluators, two part-time evaluators, five other full-time professionals, six full-time clerical, and six part-time clerical.

In evaluating the two, those figures might be a helpful part of the record.

[Comments on the above are provided separately for the record by Mr. Lewett directly following Mr. Gore's request for comments on page 149.]

I don't think you were finished yet.

Mr. **Reed**. No, Mr. Chairman. I really—my questions are rather specific. If Mr. Lewett would answer my questions, rather than erecting rather complex events, I believe it would facilitate.

Mr. **Gore**. Let's keep the tone cooperative, and I am sure Mr. Lewett will do the best he can with the responses. Go ahead.

Mr. **Reed**. All right. I have got a couple more questions to ask about this article of Mr. Lewett, if I could.

This is one of those situations that always develops in a press release by governmental officials of an unnamed source.

Mr. **Gore**. I am not sure this was a press release. This appears to be a Washington Post story that is about this particular office at DOE.

Mr. **Reed**. It could be. The fourth paragraph says: "Many come with less and expect more. Much of our day is spent stroking these people."

Mr. Lewett, I guess one of the things I want to ask is, would it not be better to give specific, clear-cut technical reasons for your findings—rather than giving the ambiguous conclusions and then having to deal with these people?

Mr. **Lewett**. That is pretty much of a loaded question. There's no question about that. I wonder if I could have a copy of the article.

Mr. **Gore**. We will provide that to you. Let me also say for the record—I feel compelled to add this. Mr. Reed, I had a constituent who took an invention to this part of DOE. He had forked a spark plug and claimed that it increased the mileage. In fact, it did. But there were some associated problems with it, and others had looked at a similar invention. I must say, when he got a response from DOE it was a rather thorough explanation of what the potential was and what the problems were. Now, that is just the only personal experience I have had on behalf of a constituent, but I think in all fairness I ought to say that for the record.

Go ahead with your questions, Mr. Reed.

Mr. LEWETT. The question being, again? Would you repeat that?

Mr. REED. What I am saying is why not give specific, simple, precise answers, rather than general conclusions that afford the submitter no real information as to why you arrive at those conclusions?

Mr. LEWETT. First of all, we have a difference of opinion. I feel that our letters are well written, generally, and we give very valuable information. I would like to point out that although we do make three recommendations a month to DOE out of every 100 inventions we get in, we also say "no," to 97. When we say "no" and give them reasons, that is also a very valuable output of the evaluation; no question.

In saying "no," however, sometimes we don't communicate very well. When we don't communicate very well, we tell the inventor, and we publish this in our brochure, "Please come back and talk by phone, and let's make sure we understand each other." And then, as you know, we also invite the inventor, if things are still not clear, to come in and talk to us face to face, and sit down with the evaluator and talk some more, to eliminate the communication problem.

Now, we have given that invitation to you, sir, and you have not come in and talked face to face. And I reiterated the invitation here just before. I would be very happy to try and eliminate this communication problem with you, if you will come in, sit down, and talk to my technical people, and try to resolve it once and for all.

Mr. REED. All right. You say the letters are generally pretty well written. Are you familiar with the internal combustion engine?

Mr. LEWETT. I have read a lot of letters—I have signed a lot of letters about internal combustion engines. They are a very popular area with inventors, sir.

Mr. REED. My question is would you know what ports and cylinders would mean with respect to internal combustion engines?

Mr. LEWETT. One of the things that my evaluators continually tell me not to do is to evaluate anything personally in public.

Now, there is no question that I know more about internal combustion engines than many of the people in the room. But I will not conduct an evaluation in public. I would ask you to talk to my technical people. That is what they are being paid for.

Mr. REED. OK—my point being that the first engine using ports in the cylinder walls, if the material that I have studied is accurate, was developed somewhere around the turn of the century. As of a few years ago, the most efficient, in terms of thermal efficiency, most efficient internal combustion engine, was a two-cycle engine utilizing ports in the cylinders.

Now, my design eliminated ports in the cylinders. Anyone who had read the submission or looked at the mechnical drawings would observe that. Yet in your July 19 letter, it states, quote: "The advantages claimed for your engine are essentially the same as those claimed for any two-cycle engine. The use of ports in the cylinder is unique."

Something that is almost basic to all two-cylinder engines and has been for in excess of half a century, that your engine still requires—an assumption, a false assumption, that my engine utilized ports in the cylinder wall. And on the basis of that assumption, four other critical conclusions were advanced.

Mr. LEWETT. That is a rather long question. I will take a couple of minutes to answer it. First off, I mentioned the communication problem as being a very difficult one. The reason it is difficult is because when we answer, it is a very personal answer. The inventor has submitted something to us in which he has stated that it is technically sound, will save energy, and is commercially practicable, and should be marketed. Because of the nature of our program, we must tell him basically that he is right or wrong, not that he came in 11th or 21st in a competition in which only 10 or 20 could receive a prize—a grant.

Now, in our evaluation, all we really have to do is to be able to say yes or no. In other words, should we recommend it to the Department of Energy, or do we disagree at some particular point?

In our first-stage evaluation, we will submit the invention disclosure for review to possibly two, three, or four different evaluators or consultants, independently, so that one reviewer does not know what the other is saying. When we do this, we get a lot of comments, but we have asked the reviewers to address basically the one question: Is this thing promising? Should we forward it or not? We do not ask for a technical critique. We cannot afford to pay for a complete technical critique, particularly on an internal combustion engine.

So basically, we have asked him, our reviewer, to say yes or no. Now, when we have paid $100 to $200 per review, we do not feel it is quite satisfactory just to pass on to the inventor a flat "No, we cannot provide a recommendation"—we pass on whatever information we can which we feel is valid.

Now, I'd like to clarify some semantics. My staff evaluator is the only evaluator. We have a tendency to refer to our consultants as evaluators; but they are basically reviewers, people who provide us with information which enables us to do the evaluation; an OERI staff member is the only evaluator. He integrates the results or comments received from consultants, and comes to a decision. He then identifies those comments that he feels are technically sound and that we should pass on. We pass on, then, as much information as we can to the inventor, together with the primary communication which is "No, we cannot provide a recommendation," or "Yes, we can."

Now, the reason, again, that we ask you to come back at us, by telephone or personally, is because we know that in a procedure like that, sometimes we will use terminology or we will express ourselves in ways which are difficult to fully understand outside the context of a complete technical critique—communication becomes difficult.

Mr. REED. Mr. Lewett——

Mr. LEWETT. If you differ with us, come back at us and ask for clarification.

Mr. REED. Mr. Lewett, I have visited with several engineers. I have received two evaluations, and no one with whom I visited—electrical engineers, aircraft mechanics, or anyone else—had any problem about understanding the function of the engine or what ports in cylinders walls were. I think that is so definitive that it is an indication of ineptness on the part of the reviewer or the person who composed the letter.

Mr. LEWETT. Or it might be an indication that the person who was giving you his opinion did not have to back it up with money, as we do. And this again is why it is essential if you are not satisfied, and you feel that we do not understand your invention, that you come and sit down face to face with our evaluator and make sure that you clarify the situation.

Mr. GORE. Let me say, we are running into some time pressures with another subcommittee that is going to have to take this room fairly soon. And there is another vote on the floor.

I think it would be helpful, Mr. Reed, if we put into the record this outline which you prepared of your dealings with this office. In order to balance the record, I think it is also fair to note that the purpose for which this particular program was established originally was slightly different from the NSF program. It was really part of the national effort to tap the ingenuity of the American people for a specific motive: to help solve the energy crisis. And at the same time, Americans were being encouraged through the media to come up with ideas. And really, they have been deluged with ideas. It is important to evaluate how they did and learn the lessons in case we need to have another such effort.

I really get the feeling that DOE has not, and does not, support this program at the highest levels. Is that an inaccurate impression? Mr. Secretary?

Mr. DEGEORGE. I do not think it is accurate, Mr. Chairman.

Mr. GORE. If you could be brief. I want to get to the other questioners.

Mr. DEGEORGE. I do not believe it is accurate, Mr. Chairman. I have tried to indicate in the opening remarks that this budget, while it is small, was not reduced, and many of this size, and others, were eliminated. It could be criticized, I think, for not assigning enough staff in the past, and I think it could be criticized from the sense of its perspective and the view of the organization from the outside on an organization chart.

But I can only tell you personally that for the last year I have supported it, and I know that the President and the Secretary does also support it. There are no enemies of this program in the Department, Mr. Chairman.

Mr. GORE. All right.

Mr. REED. I would like to ask one more question.

Mr. GORE. Sure.

Mr. REED. One of my greatest concerns about this, given the fact that only 1.3 percent of all submissions historically have been funded is what assurance do you have that good ideas are not being overlooked? And a second question: Do you have a quality control program, where, on a random basis, the conclusions of your reviewers and evaluators are critiqued? And are those reviewers and evaluators either rewarded, reprimanded, or what on the basis of their performance?

Mr. LEWETT. Yes. We are very much concerned with this question of how many we actually do miss. As I pointed out, one of the design features, first of all, is to make sure that we get multiple independent reviews which are geared, really, to surface the good invention rather than to provide a technical critique and the reasons why something should be turned down.

It is easy to turn down an invention. All I have to do is submit it to a committee of three evaluators and say, "Give me a consensus." I can guarantee that damn few things would get through.

In our contracting procedures, we have it as a principal element in our selection procedures that the first-stage evaluation review we get from an individual expert within the contractor's organization, will not be reviewed or edited by any superiors. The individual comments are to come to us, unedited, and direct from the individual. In our instructions for evaluations, we also emphasize the need for liberality on the part of those individuals.

Now, each individual that does a review—and we have some 300 people on the list now, as well as some eight contracting firms—each individual that does a review is rated by our staff evaluator, as to how the review stacks up when he makes a decision. We rate each individual reviewer on a scale of zero to four, with two being a "satisfactory," zero being a case where he has told us something that is wrong, and four where he is giving us too much. The ratings are stored in the computer system.

We review the ratings continually together with the consultants' charges and their response time. Of course, we do have to bug individual reviewers at times to get their invention reviews back in time. We keep turning over the list of consultants on the bases of response time, dollar cost, and technical accuracy. If he takes too long, if he costs too much, and/or if he is not technically as sound as he should be, we reduce our usage of his services.

Now, in addition to this, with respect to overall quality control, I did have MIT under contract back about 3 years ago to review the general process that we had designed.

Also currently as part of the overall program review which DOE is funding now to comply with the "sunset" provisions, we are preparing a questionnaire which will go out to everyone that we have turned down in first stage. We will be looking specifically for information which will tell us that, indeed, we missed one, because we want to see if there is something else that we need to do to the program to improve accuracy. Believe me, it is a question of continual and current interest.

Mr. GORE. Thank you, Mr. Lewett. We have a vote on the floor on the synthetic fuels program. This time you can depend on 8 minutes, and we will resume, then, with questions from you, Dr. Eastin. And again, the subcommittee asks your indulgence.

[Recess.]

Mr. GORE. The subcommittee will come back to order.

We will make it possible for Mr. Lewitt to review this document that we are putting into the record and offer comments for the record. We will try to manage it accordingly.

[The information to be furnished follows:]

COMMENTS SUBMITTED FOR THE RECORD BY GEORGE P. LEWETT

(insert in Transcript, Page 149, Line 3681)

In the course of the Hearings three Government-sponsored program-types were discussed and individual programs either implicitly or explicitly compared. The following comments are provided to support the comparison by identifying factors which are characteristic of program design and which therefore control program performance. The three program-types were represented in the Hearings by various Innovation Centers; the NSF Small Business Innovation Research (SBIR) Program; and the NBS/DOE Inventions Program. My comments represent a personal viewpoint and do not (except as they describe policy and operation of the Office of Energy-Related Inventions) represent the findings from studies authorized by the National Bureau of Standards or other institution.

The general purpose in each of the program-types is similar, that is, to stimulate technological innovation by individuals and small business companies. The specific programs are aimed at particular technological areas and/or population segments.

The approaches taken in the three program-types differ. In the Innovation Center approach, educational, technical, and some financial resources, are put in place to provide assistance primarily to local or regional innovators. There is a focus on supporting new business start-up due to a goal that the Center achieve a self-supporting status.

The NSF SBIR program, while atypical in its design, typifies an incentive approach in which funds are set aside for competitive award to innovators in selected subject areas and/or stage of development (NSF sets aside research funds). The NSF design in part is based on traditional competitive Government procurement practices. However, the unique phasing and selection features compensate for the weakness of the "quota" system in assuring good quality of the work funded.

In the NBS/DOE Inventions Program approach, resources are made available at the national level to provide technical assistance (evaluation/consultation by NBS and development planning and guidance by DOE). Incentive is provided by DOE grant award in cases selected in accordance with individual merit. When the number of meritorious cases is insufficient to make award of all grant funds available, the remaining funds are directed to other forms of direct support, for example to improve innovator access to educational and informational resources so as to increase the number of "supportable" inventions in the future; such usage of funds also serves the purpose of bringing the Program to the attention of potential inventor participants.

Comparative worth of the three program-types has not been established, and such assessment will be difficult, not only because they have different objectives and modes of operation, but also because the major benefits in each case are intangible. The number of successful new technologies or products or business start-ups, which emerge from the programs, can be counted, but how such innovations would have fared without the programs' help will be unknown. However, for each program, that output number is only one minor measure. The principal benefits will derive from the impact the programs have in improving the national climate for small business innovation.

Mr. Rabinow, in his remarks in this Hearing, addressed the need for climate improvement very effectively. To me, an improvement in climate will be manifested by increases in the number of practitioners in the field of innovation--the number of inventors and entrepreneurs who become active in inventing, developing and introducing new products to market. Based on my experience in conducting 10 National Innovation Workshops (described in my formal testimony) in major cities around the country in the past year, interest in the innovation field is high, and rising rapidly, in response to media emphasis on the national need to increase our innovative capabilities. Practitioners and potential practitioners, at the rate of some 250 per Workshop, typically come from an 8-state area to attend the "How-To" sessions.

I would like to comment now, in the context of the foregoing, on the figures put into the record by Mr. Gore, comparing the NSF SBIR and NBS/DOE programs. First, the number of grant awards versus the number of proposals received were compared: 11% of the proposals to NSF were awarded grants; 1.3% of the proposals to NBS/DOE were or will be awarded grants.

The percent awarded is basically a measure of the quality of the proposals and the work proposed. Incoming quality is of course controlled in the NSF program design (by restriction of subject area and by only funding research) so that the difference seen is to be expected.

We see similar differences within the NBS/DOE program when we compute the percent of awards by subject area of inventions evaluated (% of Total Submissions Expected to be Recommended--my formal testimony, Attachment 1, Figure 3). Some are higher than others, with the percent varying from .6% award for Natural Sources (of energy) to 7.2% for Industrial Processes, although the overall average is the 1.3% noted above. It should be noted further that NBS evaluation cost also varies with subject area, with cost greater for those with higher percentage of awards.

Secondly, the staffing levels are compared, with the NBS/DOE staff seen to be much greater than that of the NSF program. This difference is also to be expected considering the differences in program design; the programs do quite different things. However, the form of Mr. Gore's comparison implies that the sole beneficial output of the two programs is the number of grants awarded. In the NSF program, major benefits should derive also from the incentive effect of stimulating firms which are not awarded grants or did not compete in a particular solicitation, to prepare for future solicitations; these benefits are of course not measurable at this time.

In the NBS/DOE program, while the incentive effect is also present, the major additional benefits are tied to specific program outputs which account for the staffing level differences between NSF and NBS/OERI. The OERI staff, in addition to recommendations leading to grant awards, also produced as of March 31, 1981, approximately 8200 evaluation reports which were forwarded to individual inventors or small companies that did not receive grants; some 400 of these reports were at the second-stage evaluation level and were relatively extensive. Contractual or consultant costs paid by NBS/OERI in developing these reports exceeded $2,000,000, which was in addition to internal NBS staff and other costs. A significant percentage (10-15%) of the inventors or companies receiving the reports rebutted the evaluation findings, and received additional technical service via telephone or personal contact with OERI staff engineers and supplementary written reports.

In addition to the evaluation service, OERI staff efforts are also expended in initiating, administering, and monitoring grants to private sector agencies which provide other direct benefits to inventors and innovators. Such activities include the National Innovation Workshop and Inventor Information Resource Center projects described under Supplementary Activities in my formal testimony. The projects also serve the purpose of bringing the Program to the attention of potential participants.

It should be noted also that staff efforts involved in processing unacceptable requests for evaluation (approximately half of the 16,780 proposals received by OERI and noted in Mr. Gore's comparison) are relatively minor. Such unacceptable requests include the "perpetual motion machines" referred to during the Hearings. I estimate that our costs of handling such requests has averaged approximately $60 per item, half of which are contractor charges.

I would like to make a final comment addressing the Innovation Center concept. The Inventor Information Resource Center project mentioned above qualifies as a specific program of that type; however, the focus of the

Resource Centers is on provision of technical information and educational services. I feel that a principal weakness of the Innovation Center concept, in the applications discussed in the Hearings, is the focus on financial support of new business start-up due to the goal that the Center become self-supporting through return on investment. Such a focus is not consistent with the usual academic setting of the Innovation Centers, particularly in view of the critical need for education and instruction in the practical aspects of information transfer and other elements of the innovation process. Also, the statistics involved, specifically the low number of "good" ideas likely to be submitted to an individual Center for support, may well constitute a practical barrier to success in reaching the goal of self-supporting status.

The foregoing comments are provided principally to support comparison of the three program-types discussed. Another major topic of discussion, as introduced by Mr. Reed, has been the attitude of we in the Energy-Related Inventions Program towards the independent inventor. An article from the Washington Post wire service and a letter I wrote to the Editor of the Post in response to the article were introduced earlier into the record. I would like to append here, also for the record, to further delineate our attitude, comments I supplied to the Senate Select Committee on Small Business in Hearings held shortly after the Washington Post article. These comments are pertinent, not only because of their discussion of bias against the independent inventor, but also because of the further insight they might provide to members of this Committee on operations and findings of the Inventions Program.

U.S. DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

STATEMENT OF GEORGE P. LEWETT
CHIEF, OFFICE OF ENERGY-RELATED INVENTIONS
NATIONAL BUREAU OF STANDARDS
BEFORE
THE SELECT COMMITTEE ON SMALL BUSINESS
U.S. SENATE
SEPTEMBER 7, 1979

Mr. Chairman and Members of the Committee:

(Introductory Material Not Included)

COMMENTS

The NBS evaluation process has been designed to meet the needs of and take into account the characteristics of the independent inventor and small business. This design has been evolutionary in nature over the 4 years of OERI operation, being modified continually as our experience has increased. In the following sections I wish to share with you this experience by commenting on what we have learned about the characteristics and needs of the small inventor, and by describing the mechanisms we have introduced into the evaluation process to meet the inventors' needs.

Variety in Inventions and Inventors

Subject areas of inventions submitted have ranged through the entire spectrum of non-nuclear energy technologies: from those in the public eye such as automotive improvements and solar system designs, through manufacturing and industrial process technology, to esoteric concepts involving abstract scientific principles.

The stages of development of inventions submitted have likewise had a full range. For record-keeping purposes we have defined 10 stages in the development of a product: from concept definition, through laboratory testing, to full-scale production and marketing. Submissions received, as well as recommendations, have covered the entire range.

Inventors and small businesses have also shown very great variety. We have recommended inventions by a heating and air-conditioning technician running his own small installations and maintenance business; by an independent industrial chemist with a full-scale laboratory in his house; by a retired university professor who founded and operates a small engineering and instrumentation firm; by a firm of 40 employees engaged in developing and marketing the solar system it has designed as a new product; etc. While most submissions have been from individuals, in a great many cases submitters have indicated their ownership of or affiliation with a small company. Such companies have ranged in size from 1 to 500 employees, but most have less than 50 employees. It is not clear however, where the independent inventor leaves off and the small company begins.

It has not been feasible to deal with the variety of invention subject areas solely with staff internal to OERI or even to NBS. A network of consultants and contractual evaluation firms has been established to assist in the evaluation process. Currently, we have 8 engineering firms under contract to do this, and are making use of the individual expertise of some 115 university professors from 55 different universities, 85 private sector consultant engineers, 135 engineers and scientists in other programs within NBS, and about 30 engineers or scientists from 12 other Federal agencies.

OERI staff evaluators have been selected not only on the basis of strong technical expertise, but also on the basis of practical experience in the private sector. Their role is one of "gatekeeping;" that is, of assembling the necessary information and making the decision as to what should go forward. They tend to be inventors and to have been in small business themselves, and they have the primary ability to understand technology in subject areas far outside that in which they have technical depth. The principal technical disciplines required are mechanical and chemical engineering, and thermodynamics.

Bias

The independent inventor is notable in the history of technology for his very many significant contributions to innovation. In the recent past we have benefited by the contributions of such independent inventors as Chester Carlson, Edwin Armstrong, Christopher Cockrell, John Tytus, William Carrier and Edwin Land, to name a few, who invented respectively xerography, the FM radio, the hovercraft, continuous hot-strip rolling of steel, air-conditioning, and the Polaroid camera. Unfortunately, however, the public image of the independent inventor is not shaped as much by the accomplishments of such men, as it is by the doings of the Rube-Goldberg-type and "perpetual motion" inventor.

The resulting poor public image is the source of bias against independent inventors when they look for evaluation and support for their inventions. There are other sources of bias too--the low proportion of significant inventions which have emerged from inventor populations, the characteristically-poor presentation of their inventions by the inventors, and personal characteristics such as persistence. The result is that individuals and groups dealing with the inventors are normally geared to or organized to deal with a nuisance, rather than to carry on the laborious task of "winnowing the wheat from the chaff."

Small businesses, particularly new technology-oriented firms of up to 20 employees, share in the lack of credibility that is associated with the independent inventor. This lack of credibility can be overcome, but only by prolonged contact, which takes time and effort that the firm or the inventor cannot afford.

OERI is deliberately and consciously constituted to counteract this prevalent bias. Our objective in evaluation is emphasized as being to find the promising invention rather than to eliminate the poor one; multiple, independent opinions are obtained on inventions evaluated in First-Stage; technical material is separated from other extraneous and potentially-biasing material for evaluation purposes; a number of efforts are being directed to improve inventor presentations of their ideas; contractor and outside consultant opinions are reviewed by staff evaluators who are prepared to find evidences of bias and discount it.

Inventor Presentations of Their Ideas

Of the first 100 recommendations forwarded by NBS to DOE, 12 had been originally rejected by OERI either in the First- or Second-Stage Evaluation. This finding documents the need for one primary feature now incorporated in the evaluation process--the encouragement of dialogue between evaluator and inventor. In these cases, as in many others, the inventors had not provided complete details or substantiation for their claims. Persistence on their part and willingness to listen on the evaluators' part resulted in submission of additional information and data which enabled a change in our decision. We have found that 15-20% of the inventors respond to our rejection with a request for reconsideration and new information.

Original rejection and ensuing dialogue frequently results also in design changes to the invention by the inventor. While we cannot and do not function as a consultant service to inventors, their acceptance of our objectivity and credibility results in this type of practical assistance as an unavoidable and beneficial by-product of the evaluation.

Steps are being taken within the program to improve inventor presentations. One of particular interest is the establishment of regional operations, currently in New England and in the Northwest Pacific states. These are contractual operations with non-profit organizations who provide a local contact point for inventors and small businesses and perform the Disclosure Review and Analysis function described earlier. A particular focus of these groups is to work with inventors to properly prepare their submissions to OERI. The groups also undertake to search out among small businesses in the region, those which have new and promising energy-saving products or technology suitable for submission to OERI.

By-Products of The Evaluation Process

As noted earlier, the results of the evaluation are frequently of practical value to the inventor or company in pointing out the need for design changes, whether the invention is eventually recommendable or not. Because of the possibility that the inventor will act decisively on the results of our evaluation, perhaps to discontinue development, considerable care is taken in determining what information derived in the evaluation should be passed on. This determination is particularly troublesome when rejections occur in the First-Stage Evaluation, since economics preclude at that stage, in-depth technical analysis of invention oepration, or validation of a technical finding which is submitted by a consultant who was asked to provide only a brief opinion as to the "promise" of the invention. We attempt to maximize the findings which can be transmitted to the inventor but this is limited by the "technical screen" nature of First-Stage Evaluations.

When our evaluation results are accepted by a small business as being objective and credible, and such acceptance is increasing, we have received indications that small business finds this evaluation service to be beneficial in guiding their actions in development or marketing.

In selected cases our results are provided, in our letter of notification to the inventor, in such terms that the letter can be used to establish the inventor's credibility with other Federal programs such as the Small Business Administration (SBA) loan program and the DOE Appropriate Technology Program. A typical letter of this type will provide the address of the local SBA district office, and state: "While Federal support is not appropriate under this Inventions Program, this letter will attest to our opinion that your invention is technically valid, will have an impact on energy conservation, and seems commercially and economically competitive."

We understand that such letters have been of value to the inventor, and that, in general, a favorable letter carrying statements on technical feasibility in particular does open doors which earlier were closed or at least difficult for the inventor or small business to open. In effect, the evaluation service provided by OERI, regardless of whether support is forthcoming under the program, has an impact in establishing inventor or small business credibility with other sources of support, in the private as well as in the public sector.

A principal need of inventors and small businesses in developing new technology is for information on the state-of-the-art of the technology in the subject areas of their interest. The small business is often precluded for economic reasons from participation in technical conferences and symposia which are a principal means of disseminating such information. Also the small business is often not knowledgeable about the existence of and means for accessing technical information sources. The NBS evaluation service responds to this need to some extent now. In the interest of stimulating innovation and improving the quality of inventions submitted to OERI, we are undertaking to improve and increase the amount of state-of-the-art information which we provide as feedback to the inventor. We feel that this will be of particular value in that such feedback will address areas in which the small business or inventor is already somewhat knowledgeable and certainly very interested.

Program Promotion

The program has received considerable publicity and we have disseminated program information to the inventors and small business community. In so doing we emphasize the value of our free evaluation service in itself as well as the real possibility of obtaining financial support from DOE.

A question of principal interest to inventors has been that of their proprietary rights, how they are safeguarded during the evaluation process and how they may be compromised by support action. The safeguards we have instituted to insure confidentiality in evaluation and prevent conflict of interest situations from developing on the part of our evaluators, are considered satisfactory by inventors. Treatment by DOE of the question of rights, as will be discussed by Mr. Donohoe, seems also to be satisfactory and has not been a factor in discouraging use of the program by inventors.

We feel the program is not being used to the extent it could be by the professional scientist/engineer in private practice or affiliated with universities, and by the small, high-technology, R & D firm. It may well be that conventional sources of support are satisfactory for this particular population, and they do not feel the need to make use of the NBS/DOE Inventions Program. We feel however, that part of the problem may be that our OERI program is identified with the denigrating image often held of the independent inventor discussed earlier. In any case we are initiating promotional efforts to reach this population more effectively and increase their participation in the NBS/DOE Inventions Program.

One such effort is being initiated with the cooperation of the Patent and Trademark Office (PTO). We are attempting to identify in the patent classification system, subject areas which seem particularly promising with respect to potential for significant energy innovation. The PTO is then to provide mailing information on individuals and firms actively working in such areas as evidenced by patenting activity in the past 5 years. A direct mail effort then will be made to bring the evaluation service and grant potential to the attention of such individuals and firms.

Field experience by the supporting firms in New England and the Northwest has indicated that many inventors and small firms are very reluctant to look for support from the Federal Government. Reasons given vary from the time and trouble involved, to their concern for proprietary rights. While the supporting firms in the New England and the Northwest have been somewhat successful in overcoming such reluctance, it is clear that some inventors and businesses will not make use of the program even when they are fully aware of its existence and method of operation.

FINAL REMARKS

It is known that independent inventors and small businesses have been a potent force in technological innovation in the past. Our experience clearly indicates that this fact has not changed. Out of the continual flow of inventions into our program, we continue to find a percentage which are significantly new. As has been the experience of programs like ours in the past, that percentage is small but it is real and is proving worthwhile. Mr. Donohoe will provide specifics on DOE support to date of inventions that NBS has recommended; and a joint NBS/DOE effort is being initiated to determine effectiveness of the Inventions Program. Generally, however, it appears that inventions processed through the program and reaching the marketplace, will generate substantial energy savings and have a beneficial impact on the economy.

The volume of the flow is significant. It indicates that there is a very large population of innovative individuals working actively outside of large company laboratories to introduce new energy products and technology. They are highly-motivated and persistent, and whether the major technological breakthroughs come from their ranks or not, the cumulative impact of their contributions is bound to be substantial.

It has been said that the technological breakthroughs in energy are more likely to come from the large corporate laboratories and large-scale Government-sponsored R & D activities. While this may be so, it is not because the innate capabilities of the independent inventor and small business population are deficient. It is principally because of differences between their environments and resources, and those of the large-scale activities.

The NBS/DOE Inventions Program, in a small way, tends to compensate for some of the differences. To some extent it provides the independent inventor with the peer review and evaluation facility which is intrinsic to operation within the corporate environment. It provides, in the case of a grant, some relief from the day-to-day economic pressures on the small inventor.

The long-range objectives of the Inventions Program are in keeping with these latter remarks, and I would like to state them in conclusion:

- o To create a sheltered environment wherein with Federal assistance independent inventors and small businesses are provided improved opportunities to make significant contributions toward solving our Nation's energy problems.
- o To provide a system of means and incentives for individuals and small business companies to develop, exercise, and improve their capabilities for invention and ultimate innovation with will bring inventions into general use where the energy savings will be realized in the shortest time possible.

Thank you, Mr. Chairman. I will be pleased to answer any questions you or other members of Committee might have.

Mr. Gore. Mr. Eastin, please proceed.

Mr. Eastin. I am at a loss for words here. I guess I had some things that I wanted to say that were not specific. I dealt with Mr. Lewett's program too, and I do not know what the reason—I suspect it is because after hearing the numbers, it takes about 2 years from the time a person applies during those initial stages before you actually got back, were able to get back to him. This was a startup administrative thing that just was a fact of life, I presume.

Mr. Lewett. You are talking about how long it takes us to respond or get an answer out, once we get a submission?

Mr. Eastin. The evaluation answered and so forth.

Mr. Lewett. Let me address that question. What we call response time, this is the interval between the time at which an inventor submits something to us, and the time that we give him an answer, that is, say yes or no, and provide the results.

First off, when we get a submission, the first thing we do is we send the inventor a computer-generated sheet which says we have received your submission; that happens within about 3 days. The next thing that happens—2-3 weeks—is he will get a letter from us, again computer-generated, which says that we have reviewed your submission, it is accepted for evaluation at the first-stage level or not accepted. After it is accepted into first stage, the time will vary considerably, depending upon many things.

Now, the average response time for all inventions that have been accepted and evaluated right now is running about 20 weeks. That has come down from about 40 weeks, I guess, maybe 2, 3 years ago, but it still varies considerably in the individual case. There are many factors contributing to that variation. One of the principal factors is the time involved in getting the multiple independent reviews from consultants. These are usually top technical people in their fields. They are people that do not find our business particularly attractive and they are busy people. Therefore, we cannot put too much pressure on them to return their evaluations as rapidly as we would like.

That adds a significant time factor quite often. Sometimes, in the odd case, a consultant may even shelve our review request for 6 or 8 weeks; we end up calling him on the phone and sending him letter after letter before we finally get him to respond. Often, too, in some rather esoteric technical areas, we have difficulty in locating an evaluator. In some areas it has taken us 3 or 4 months before we can find somebody that we consider an acknowledged expert in the field; and who is not engaged in production or development of a product in that field such that a conflict of interest would occur.

In other cases, we find that quite often we will be doing an evaluation and the inventor will write or call and say "hey, wait a minute, I want to add some additional information." In talking to him, he will say, "Hold off. Don't do any more until I get back to you." Then he comes back to us in 6 months.

These are two major reasons as to why we can take much longer than the average in any individual case.

Overriding these, the reason that our response time may be long is principally because of the failsafe procedures that we have built into the system to make sure that we do not miss a good invention.

If we are taking a long time on the average, it is to make sure that we do not miss the good one. If we do see something that we recognize rapidly as worthwhile, we move it and put it on a very fast track. That does not happen too often, unfortunately.

Speaking from the experience of having signed about 8,000 letters, mostly saying "no," over the past 6 years, it is not easy to recognize a good invention. Believe me, we try very hard to find recommendable inventions, because if we do not recommend inventions we are going to be out of a job, and very frankly, we like our job.

Thank you.

Mr. EASTIN. I asked because of the response time I had had and I wondered whether it was better now or—it took a little over 2 years before I got my first-stage acceptance, and then reasonably rapidly—I cannot remember about 6 months after that I got the second-stage evaluation and then I pursued a 3-year policy of "hey, I think you're wrong," that approach. And then I talked to Mr. Coultas last summer, then, who was the reviewer on my project and I prepared considerably more information and you still decided that it was not energy related, and so I decided you can lead a horse to water but you can't make him drink.

Mr. LEWETT. Yours is a pretty good illustration of the way the process works, in that we turned you down at the first stage and then you came back at us——

Mr. EASTIN. You turned me down at the second stage.

Mr. LEWETT. We turned you down at the first stage first, I'm pretty sure.

Mr. EASTIN. No.

Mr. LEWETT. I was under the impression that we had rejected you in the first stage and we heard from you, and then went into a second-stage evaluation. For the record—impression was wrong. Mr. Eastin was not turned down in first stage, only in second stage as he indicated. In any case the final findings were that what you proposed was technically sound, was worthwhile doing, and commercially practicable. But unfortunately, it was not in our charter because we disagreed with you about the energy impact; we did not see that energy savings could be significant.

Mr. EASTIN. I'm glad you said that, it was not in your charter.

Mr. LEWETT. Our turning you down was strictly because of the energy impact.

I have a question for you. In the letter that we did send you, the last letter after you rebutted and we answered, I think we suggested to you that you go to see the Small Business Administration and show them the letter in which we said something like: "This will attest to our opinion that your process in technically sound and should be commercially competitive and should have a favorable impact," or something of this type. Did you take that to the SBA? Or did this have and bearing on your getting the funding from the innovation center?

Mr. EASTIN. This did not have any bearing on the innovation center funding. They did not know about that at the time. I did take it to SBA. I also took it to Appropriate Technology, as you had recommended. At Appropriate Technology they said there was too much science. At your level it was not energy related. It was a fine invention, it was technically sound, it was economically sound; but was not energy related. I still have a hard time digesting that. I guess I just wanted to—my main concern was not whether I got turned down. I can understand that, coming through the system. I have lived in the bureaucracies too. My main concern was the initial response time of 2 years. I do not think that individual inventors can be held over a 2-year period.

Mr. GORE. When was this, Mr. Eastin?

Mr. EASTIN. This was in 1975, September 1975. And I got a response on the first stage evaluation—I got the notices and things that it was going through the mail, and a little diagram.

Mr. LEWETT. We were in rough shape in 1975. I think we started the program with six people and one part-time evaluator. I think the first evaluator came on in September 1975.

Mr. GORE. Your earlier testimony was that the response time is down to 20 weeks from 40 weeks, but evidently in the earlier stages it was 100 weeks.

Mr. LEWETT. Yes, we had to figure out what we were going to do with the inventions coming in for evaluations. (NOTE.—Average response times by period are given in the formal testimony, attachment No. 1. Response times for items received early in the program did tend to be larger, however, the average for evaluations completed in any 3-month period never exceeded 45 weeks. The number of evaluations for which response time exceeded 100 weeks, is about 150 of the 8,000 conducted since the beginning of the program.)

Mr. EASTIN. That answers my question on that, and I guess I would just like to make the point in relation to this that my experience with the Center for Innovation was so different than my experiences with any of the other things within DOE, within USDA. I spent time with several people within USDA that says there is no charter for helping people like you. You have to be with a university or you have to be with someone who is a contract research organization. And I guess what upset me the most was the allegation that I got in three or four offices within USDA and SBA and NSF, that they told me, hey, there's set-up over here in OERI for the purpose of having you guys have something to apply to. They want to work. They are spending $5 million a year on who? NBS, and NBS is the fall guy. They are the ones that get the heave. And in the meantime, all of these individuals that can cause all of these problems are causing them for NBS and not for DOE.

And I do not know whether there is anything to that or not. I know it was—the people, I am sure, can respond. I was told that by more than one of the people within the Washington——

Mr. GORE. Certainly it would appear from your questions, and those of Mr. Reed, that DOE might consider an overhaul here. But that is something that we will address in our subcommittee report.

Just briefly, Mr. Lewett, why is Mr. Eastin's invention not energy related? It seems so clearly to be energy related.

Mr. LEWETT. I cannot give you an answer here. We would like to talk to Mr. Eastin further, particularly, while he is here and can sit down face to face with my staff engineer.

[NOTE.—Copy of OERI's last evaluation report to Mr. Eastin, giving reasons why we do not consider his invention sufficiently energy conservative to warrant our support, is submitted for the record.]

[The information follows:]

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

JUL 30 1980

Mr. John A. Eastin
P.O. Box 398
Grant, NE 69140

Dear Mr. Eastin:

We have again evaluated your invention "Manufacturing and Using Nitrogen Fertilizers on the Farm." This has been a very extensive reevaluation, made by members of our staff, and included personal conversations with many agronomists, chemical engineers, manufacturers, and farmers. To set the stage; our reevaluation only covered the portion of your invention that would convert anhydrous ammonia to a water solution fertilizer. The idea of ammonia manufacture on the farm was not considered, and there is little reason to believe that this would be a viable farm process. The conversion of ammonia was evaluated from several standpoints.

AGRONOMY: A number of agronomists were contacted, both those suggested by your letter and others. Generally they were reluctant to state any concrete fact regarding whether or not plants preferred their nitrogen diet as a nitrate or an ammonia. This is how the question was addressed, and in retrospect, the question was poorly phrased. It was concluded, however, that if one speaks of corn, it is very difficult to apply anhydrous ammonia after the corn is over a few inches tall. It is generally considered that the nitrogen fertilizer is best applied as it is needed by the crop, and in relatively small doses as opposed to a single large, or even two fairly large doses. The maximum need for nitrogen by the corn crop is after the stalks are relatively mature, and during the earing season. Obviously, it is impossible to run the conventional ammonia knives through the field at this time. If the crop is not irrigated, there is almost no way that fertilizer can be applied to a nearly mature corn crop without severe damange to the crop. Thus to maximize the utility of fertilizer, it should be applied with the irrigation water.

Although variable rates may be considered, about 10% of the nitrogen per inch of water per acre is nominal. If ammonia is fed directly into the irrigation water, the solution is not affected and a large amount (up to 50%) of the ammonia is lost as a gas at the sprinkler head. It has been suggested that sulfuric acid be added at the same time to effect a better solubility. This has been tried, and it was found that the amount of acid required to keep the volatile losses reasonable was essentially the stoichiometric amount required to form ammonium sulfate. This is not economical.

In addition to the ammonia loss, the ammonia reacts with impurities in the water, usually calcium carbonate, to form immediate precipitates. Further, the ammonia in the water can be very corrosive to irrigation plumbing. For these reasons, the direct solution of ammonia in irrigation water is not a viable procedure.

CHEMICAL ENGINEERING: The proposed system involves a fairly complex set of chemical reactions that must be controlled to have favorable kinetics and product yield. This is discussed in the American Chemical Society Monograph "Fertilizer Nitrogen-Its Chemistry and Technology" by Vincent Sauchelli, Chapter Seven (pp. 99-125), Reinhold Publishing 1964.

Considerable care must be taken in the design and operation of the ammonia oxidizer. The thru put rate must be fairly accurately controlled or the overall yield will quickly drop to about 85%. Commercial plants should run around 98% yield. Unwanted side reactions can cause conversion of ammonia into nitrogen gas and water. Platinum screens must be used and these are lost at a rate of up to .006 oz./ton HNO_3 produced in an atmospheric pressure process as proposed here. Platinum currently costs around $600/oz. This has not been accounted for in the proposed process; nor has the loss of ammonia been included, which would be more critical.

A commercial process will credit about 1 ton of 150 psig. steam/ton of HNO_3 produced for heats of reaction and heat of solution energy recovered. The proposed system would dissipate this energy in cooling water.

The proposed system will generate various oxides of nitrogen, as does a commercial process, but in greater volume unless adequately controlled. Whether EPA would be concerned is unclear.

There is little doubt that the proposed system will produce ammonium nitrate. However, when the losses in nitrogen yield and unrecovered energy are accounted for, there is little likelihood that it will be energy efficient or economically attractive compared to use of anhydrous ammonia. Whether it is economic compared to 29.4% aqueous ammonia is not clear, and probably must be determined for each individual farm or installation. Because we do not see that your process is significantly superior in energy efficient performance, we regret that we cannot recommend Government assistance under this inventions program.

Nevertheless the process is technically valid and the principle involved is a valuable one. The ability to manufacture an aqueous ammonia solution from anhydrous ammonia at the site of irrigation is helpful for fertilization of crops at the proper time, and thus giving increased yields. Development, manufacture, and marketing of the system should therefore be encouraged even though the relatively low potential impact on the energy situation at the national level does not permit support under this program.

You may wish to pursue the idea with your local Small Business Administration and Appropriate Technology offices. The energy-related programs these agencies administer could be suitable to provide support in view of potential commercial feasibility and energy impact at local or regional levels. Their addresses are:

Small Business Administration
Nineteenth and Farnum Streets
2nd Floor
Omaha, NE 68102

Appropriate Technology Program
U.S. Department of Energy
324 E. 11th Street
Kansas City, MO 64106

If you do contact these agencies, this letter and the enclosed report will attest to our opinion that, if successfully developed and marketed, the ammonia-into-irrigation-water process will operate about as claimed and can result in increased crop yields, and reduced dependence on natural gas.

We wish you well in your endeavor even though we are unable to recommend your invention to the Department of Energy as a candidate for their support under this program. If you have any questions, they can be addressed to Mr. T. A. Coultas at (301) 921-3583.

Your interest and participation in our evaluation program are greatly appreciated.

Sincerely,
Original Signed by
George P. Lewett

George P. Lewett
Chief, Office of Energy-Related Inventions

Enclosure

Mr. **Gore**. I think he is in better shape now.

Mr. **Eastin**. I think—it had to do with evaluators. The technical evaluation was good. I think they don't have agronomists on the evaluation team. I think it is that simple.

Mr. **Lewett**. We do not have an agronomist on our team because again we are restricted, you know, to five people who are very strong in specific areas, principally engineers with lots of experience in the private sector. But they are not so good that they can cover every subject area.

Mr. **Gore**. One of the directions we might be looking in, Mr. DeGeorge, this is not necessarily a suggestion to you but to give you some insight into our thinking on the subcommittee, the success of the NSF program is clearly related in some way to a prescreening of applications by way of giving applicants a preliminary idea of the kind of thing that you are looking for. It may be that you can improve the program by looking for some way to focus the applications.

Mr. **DeGeorge**. I agree with you, Mr. Chairman. One of the comments I tried to make earlier in today's hearing was that I think there is something inherently inconsistent with the process that only puts out of NBS 1 percent of what goes into NBS, and we invest a great deal of the money in that end of the process. We could come up with a more process-oriented, specifically more targeted area. There is some technology in the field, for instance, that I think is either so far out—energy conversion, solar repowering—that I think perhaps there are vast and multi-billion-dollar investments that I think you might say that you specifically make a call or a series of calls for work in specific energy-oriented areas. The question, though, sir, is really what do you want out of this program? Do you want all inventors to have an opportunity to be reviewed, or do you want the maximum numbers of inventions at the other end? I think we have stumbled because we have tried to do both, and I think that we have to target on that question.

Mr. **Gore**. I think that is right. We do not want a national pen pal for everybody who is trying to help solve the energy crisis. There is some value in that, but I guess we want to look at ways to orient more toward getting innovative developments into the mainstream. We have to move along.

Mr. **Eastin**. I would like to make one comment. I think that the Center for Innovation approach—I have been sitting here and listening to this and I have been thinking about listening to the people running these agencies, and I know the problems that they have. It gives them individual contact with the inventor, the guy out in the field, and they have a fieldman that came to look at mine. It would never have been approved if it depended on somebody to evaluate the thing back at the Center for Innovation, probably evaluated overall potential. But then they sent a fieldman. The fieldman took me to a person whom he respected who was in the business and he said is this malarky? What is it? And the guy said, well, gee, I will get involved. I think that is the kind of a thing—like begets like. If you're going to put it back here in a bureaucracy, it's going to have to be a bureaucracy that puts it back here, a university, a large company, and so on that is equipped to deal with you people. The individual isn't.

You need two phases to the program. And NSF program, obviously it is a good one and it is dealing with a certain type of people. That's why they get the 10-percent response. These guys are flooded with everything. Everybody that has ever done anything about energy is—you have got your letters, too. That is why there is 1 percent. There is no way they can get a guy out in the field to make a judgment on a personal basis.

Mr. **DeGeorge**. Your question is more than fair, Mr. Chairman. I think we ought to find a way to look at it together.

Mr. **Gore**. Fine. Mr. Mason?

Mr. **Mason**. I have a comment. I am not so discouraged as you other people seem to be. It strikes me that you do have qualitatively different kinds of inventors. You have 16,000 people who are perhaps amateurs. You are trying to go through their ideas. It is a lot like asking 16,000 high school kids to write poetry. You might get a couple of good poems and that is what you are after. And it costs money to do it. The question is, are those poems worth doing? That is really the question. So it really seems to me you are probably doing as good a job as could be done in an American corporation, because by God, I have had inventions take a lot longer than you have to be analyzed. And the answer is not a complicated answer. It is no. You see?

Mr. **Gore**. That is a useful comment.

Mr. **Mason**. That's it.

Mr. **Rabinow**. Well, I listened to this discussion of specifics and I would like to make a general statement. First of all, I do not agree that we should make it more difficult to apply for help. I would like to see it made much easier. I would like to see the program expanded, that all inventions, not only energy related, but all inventions have some place where they can be evaluated. I do not say this because you are going to get returns dollar for dollar. Let's cut out the nonsense of "return on the buck." If we spend 7 million bucks at NBS for 3 years and we get two inventions that made money, we didn't waste our efforts.

You have to understand that there is a question of climate in this country, gentleman. Inventors are dying on the vine, not because we do not have the genes or the genius. We have. That does not change. But there is a climate in the country that either makes you play basketball or soccer. We play basketball. We do not play soccer. If you want a Pele, you go to South America or Europe. If you want great tennis players, you give them awards. You've got to make them heros. This is what these programs are supposed to do. Their effect on the country is not whether or not you or you get an award or I get a medal. The thing is, does it create invention?

We had a situation in this country after the war where the colleges stopped teaching engineering. They taught physics because they decided engineering would be taught later by industry itself. We produced a whole generation or two of engineers who did not know how to design, for example. Finally, the National Inventors Council had a meeting at Woods Hole in 1965 and the question was: Can you educate people to invent? It was 1 week's meeting. We had people from all of the great colleges, heads of departments, industry speakers, inventors and so on. And the consensus was that you can educate people to invent. That does not mean you can make everybody invent. But if you teach thousands of people and you teach them creative science, you will get some inventors.

You have to realize that invention is an art form, and if you are talking about making money on it, and that everything has to be just right and there should be a certain return and that for every 10,000 proposals you get 1 good one, or 10, or 100, it is like asking that all opera should support itself. It never supported itself. Most arts do not support themselves.

If you want culture in a city, you build a Kennedy Center. It loses money, and you invite performers and you have a cultural center that suddenly changed the life of Washington. I came to Washington in 1938 and it was a hick town. They pulled in the sidewalks at 8 p.m. and rolled them up. There was no place to go except to a movie. Now Washington is a great cultural center. Even the National Theater has good plays now. So does the Warner.

The fact is, if you want inventions, gentlemen, stop worrying about whether you are going to get every inventor to make money. You have to create a climate where high school kids will want to be inventors. You have to create a climate where college kids want to be inventors. You have to create a climate where people who invent will teach. It is hard to get good engineering teachers because my daughter gets more money as a computer programer than most college professors get for teaching advanced courses.

We have a problem in the country. I listened to all of these discussions about whether it is good—that of the 16,000 inventions we approved 1 percent. The Inventors Council received 625,000. We approved less than one-half of 1 percent. We heard that the Science Foundation approved 10 percent. All of this does not mean much to me. I would like to see inventors get more money, but I will be damned if I would suggest that we should approve every invention. We could have a rubber stamp that we would use for everybody who sends in an invention. It would say "Approved." So 16,000 inventions would have gotten approval, and if anyone thinks that would be good for the country, he is crazy. It is better to reject perpetual motion and other such inventions.

I spend all kinds of time arguing with people who come to me with patents on perpetual motion machines. The Patent Office is overloaded, understaffed, and for reasons which I can't describe, people get patents on perpetual motion machines. Then I have to sit with the inventor and say to him, "No, it won't work," and I tell them why. And he says, "but the Department of Commerce gave me a patent." And I say, "I am not responsible for what the Patent Office does."

I collect patents on perpetual motion machines. I do not publish them because I like the Patent Office, but I have a a very large collection of useless patents, infinitely variable gear boxes which cannot be made, perpetual motion machines of all types, water pressure machines that use no water.

An inventor came to me and he said, I have a machine that uses water pressure but uses no water. You can put it at the bottom of the ocean and it will run. If you connect it to a faucet it will run but will use no water. I said, this I have to see, you have a model? So I get the man into the lab. We connect it to a water system and we turn on the faucet and the piston moves but the floor gets covered with water. I said, what's that? And he said, that's leakage. I said, you fix the leakage and come back, and he never came back. [Laughter.]

We spend a great deal of time with inventors. We go through a particular invention over and over again. We often spend a half-hour or an hour on the telephone. All I can say is, all this is not really important.

The important thing is that the inventors feel that there is some place in the Government that does give a damn. They come to us and say, where can I get help with an invention on cutting wood or something like that, and I say, "It is not energy-related." And he says, "But my saw is better; it cuts a thinner cut." And I say, "I'm sorry. There is no place in the Government where you can go now with that invention." There really isn't.

Mr. **Gore**. Mr. Rabinow, I think what you are saying is true, but we have got a problem when a Mr. Eastin and Mr. Reed are turned down along with those that violate the laws of thermodynamics.

Mr. **Rabinow**. I looked over your file just now, Mr. Reed. I do not see anything about ports in the cylinders. We're talking about valves and valve openings.

I will look through that file, even though I'm not involved in it. We will look through it again just to see if we have made a mistake or whether it was a question of semantics in one of the letters. I just looked through all of that file and I did not see what you quoted.

However, we can make mistakes. We are human. The Patent Office makes errors because they are human. It takes 2 or 3 years to get a patent through, and they reject patents, just like everybody else, because they cannot rubberstamp them. And they tell me that the easiest thing to do is to issue a patent. Rejection always means blood on the floor. And this happens to us. Nothing would be easier for us than for Mr. Lewett to just approve the invention.

My point is that these programs are important not because they reward some inventor, because the amount of money is really quite trivial. It is important to have the proper climate in this country, a climate that, unfortunately, is turning sour. I would like to take a couple of minutes, if I may, to give you some evidence on this.

I have in front of me a piece of paper that was sent to me by the Patent Office last week. It has the following information: The year for which we have total statistics, for 1979, the Japanese patents issued as follows—I will round off the numbers—"151,000 applications filed by the Japanese and 24,000 applications filed in Japan by foreigners." "35,000 patents issued to Japanese, and 9,000 issued to foreigners." So, here is Japan—with a population half of ours—files 151,000 applications for patents.

The U.S. picture is as follows: "61,000 filed by U.S. residents; 40,000 filed by foreigners." That is 40 percent in round numbers by foreigners—"31,000 issued to Americans and 18,000, roughly, issued to foreigners."

Now we have a population twice as large—does anybody know the exact number? It is about twice as large as Japan, and we filed one-third as many patents.

Mr. Gore. 130 million.

Mr. Rabinow. I have not missed an issue of the Patent Gazette in 30 years. This is issued each week, and out of this publication you get some interesting information—not only what is new, and most of it, of course, is of minor improvements, but you find out who is doing what in what fields.

Take, for example, reading machines—my first machine is at the Smithsonian. All of the patents are now issued to Japanese. Record players, Japanese. Textiles are Swiss. Casting of metal, continuous casting, is European. Optical devices are almost all Japanese. The Germans admit the Japanese make better lenses.

The patents are not only on minor improvements. They are now on basic stuff. Devices that make electric motors run without brushes—those are Japanese—and the patents on automobile engines are almost all Japanese, about 80 or 90 percent. The Patent Office compiles these figures—who gets what patents in what field. And while they are getting 40 percent of U.S. patents, in important fields it is 90 percent, and it is rising. And it bothers me that all of my record players, that move the cartridge in a straight line, are made by nine companies now, because my patent expired last year. All nine are outside of the United States—Denmark, Switzerland, Spain, and six in Japan—Sony, Panasonic, et cetera. Not a single American company makes such a phonograph.

And the reason for this is this. Harman-Kardon had a license from me. Harman-Kardon was eventually owned by Beatrice Foods. Beatrice Foods owns 500 companies, and they manage them with 200 people. I asked Harman-Kardon, "Did you ever meet the top management?" And he said, "No."

So the situation is that we have tremendous conglomerates where a single U.S. company can have 200 subsidiaries. RCA owns Hertz, a publishing house, a food company, a bank, and incidentally a radio company that makes radio sets, or used to. You have a situation where, because of the size of the business, that they cannot bother with individual little companies. So Harman-Kardon did not make good record players, so it was sold to the Japanese and it is now a Japanese company. Only the name remains. Everything is designed in Japan and sold under the Harman-Kardon name.

This is true of Zenith. When Zenith was disbanded, I talked to the ex-research director, and he said, "I have a wonderful job—more money than I had at Zenith." I said, "What about the other engineers?" And he said, "They got jobs." And I said, "What are we going to do if there's a war on and we need radio engineers as we did in the last war, and we have to build guided missiles and all sorts of electronic stuff?" And he said, "We will have to import the engineers from Taiwan."

Big joke. And this, gentlemen, is what I would like to close with. The large companies have an interest in making money because they are so large that the management simply cannot be technically expert in the things they build. There is no way for Beatrice Foods' management to technically handle the 500 companies they run.

What they do is, they become bankers. They become business managers. This they do very well, and they sell and buy companies like I buy a suit of clothes. I think I spend more time on buying a suit of clothes and I wear it longer than they do a company. If it is a loss, the Government pays half the loss. If it makes money, they keep it. They do what they do very well.

The result of that will be that small companies will have great trouble staying alive. Sometimes they will be bought by large companies, as my company was by Control Data. It's the most money I ever made.

What is going to happen is that innovation will die because big companies do not like innovation. It is risky, it is expensive and it is very difficult for a large company to innovate. When I was at Control Data, it was much harder to be an inventor than when I was at Rabinow Engineering.

The large companies no longer compete with each other. This I learned from my friends at Brookings. When I have half the industry, and you have the other half, we would be stupid to compete with each other on price. We would both lose.

I am not accusing them of getting together in smoke-filled rooms. I am not accusing them of collusion. I am just saying that when you are very large, you do not compete on price.

Mr. GORE. Laziness.

Mr. RABINOW. Not just laziness. It makes good economic sense to keep the price up.

There was an "IBM umbrella" over the whole computer industry, because IBM knew if they lowered the price, the others would lower, and they would both lose. I believe that IBM hoped that the others would make money also, because of the antitrust considerations.

The best evidence today is that at the end of the present century, between 20 and 50 companies will control 90 percent of the world's business. This will destroy the capitalist system. I'm quite sure that it will also destroy personal freedom. When you have that much concentration of wealth, it changes the economic and social and the political life of the country.

There are basic and important problems of keeping small companies alive. I do not think small companies will save the country as regards our export trade. Let's not kid each other. While they are important—half the gross national product is made by small companies, and while most of the technical innovations are in the small companies, the export business is in the hands of the large companies.

Unless the large companies are needled by the little guys, unless the large companies are forced to compete with guys like you and me, the large companies will not compete with each other.

So this is the important thing. We have to keep inventors inventing. We have to keep small companies innovative. And we don't have to worry about how much money the Government spends, whether it is $6 or $7 million. This is peanuts. The large companies do not like small companies. They do not support them.

The question was raised yesterday: Why don't large companies support small companies as does Control Data? The reason is they don't like them. They are of no use to them. If they support a small independent company, the invention it may produce may be of no use to the big company. It may be useful to somebody else. This is like education; when you educate me and spend money on my education, what I may produce as a result of that may not help you at all. It may help your competitor.

Big companies do not particularly like patents. The chemical companies do. The automobile people do not. The computer people do not. The electrical companies do not. Patents are a damned nuisance. That is what the vice presidents of two of the largest companies in America told me: "Patents are a nuisance."

Don't expect them to support the patent system. The Patent Office is in terrible shape. Patents are missing from the files, and nobody gives a damn about this. I do, and it is a goldarned shame.

All I can say is let's support the small inventor, not because he's going to save the country, but because he will keep the big guys honest. And sometimes they are absorbed and they go into the main stream of our society.

Unless we get the big companies to change their attitudes—and this is perhaps possible—unless we watch what conglomerates do with their money, I think we will have real trouble.

I am sorry I'm so pessimistic, gentlemen, but it is a very serious problem.

Mr. GORE. Thank you very much. And I think that is a good note on which to conclude this 2-day hearing. I hope others throughout this country and the Justice Department and other branches of the Government and all parts of this country will be able to hear your ideas and those expressed by the other panelists, both today and yesterday.

And to all of our witnesses on both days, I would like to express the thanks of the subcommittee. I think it has been a most productive 2-day hearing.

And with that, we will stand adjourned.

[Whereupon, at 2:30 p.m., the hearing was adjourned.]

APPENDIX I

APPENDIX I

Supplemental Statement of John A. Eastin

I want to relate some thoughts about innovation per se, the general climate for technological innovation in the United States, and the current as well as potential activities and interactions of government-large corporations-the financial community-academia-small businesses and last but not least individuals as they relate to technological innovation. I am not here to represent an organization or an agency. My remarks are those of an INDIVIDUAL who has been involved in research and development in the corporate and academic communities, has worked as an individual in research and development on a high technology invention and I am currently working on the manufacturing prototype of my invention with the hopes of commercializing the invention. The specifics of my background in research and development are a B.S. degree from the University of Nebraska, M.S. and PhD. degrees from Purdue University, 6 years as a faculty member at the University of Wisconsin, 5 years as a basic research scientist for DeKalb Ag. Res. Inc. and finally the past 8 years as an inventor-farmer-small businessman. My interest is in the stimulation of technological innovation in the United States and I hope my remarks will be of help to you as background for your work in fashioning a realistic SBIR legislative approach to governments involvement in that goal.

Individuals, Small Businesses and Innovation

Innovation has historically been the province of INDIVIDUALS. Reinforcement of that fact as it applies to the United States can come from many sources but the example given by John Kenneth Galbraith is as compelling as anything that can be said on the matter. He points out that virtually all of todays Fortune 500 companies evolved from an INDIVIDUAL who developed an idea. That fact speaks for itself. Galbraith goes on to point out that as such corporations grow and reach a stage where they are not dominated by the original entreprenuer there is often a period of collective management and innovation with much initiative and vigor displayed. This stage in corporate growth can be likened to the structure existing in many of todays small businesses where we know innovation flourishes when the resources are available. Recent studies (House Science and Technology Oversight Subcommittee Hearings Testimony July 22, 1981) clearly establish that today small businesses and particularly individuals who are the dominant force in those businesses, are very efficient at bringing about technological innovation and especially so when compared to large corporations. This current and historical role of individuals as well as small businesses in innovation should be heeded and be the cornerstone for any SBIR program you structure to stimulate technological innovation.

Bureaucracies and Innovation

Bureaucracies in general bury the individual. Consequently, innovation is not one of their strong points and in general the larger the bureaucracy the less innovation. The correlation holds well for organizations ranging from the largest socialist societies down through the private sector corporate bureaucracies. Todays society in the United States has come a long way down the road toward being substantially bureaucratized. This is true for the private sector as well as for government and academia. Again, it associated one once his interest has been peaked and he knows a format exists where he has the potential to get assistance.

would be difficult to describe the situation as well as Galbraith has done so I refer you to his remarks (exhibit 1). He notes that as corporations grow they generally become bureaucracies run by management teams. "Short term planning takes the place of long term planning, analysis becomes a surrogate for action and innovation has an aspect of danger." It might be paraphrased to say that analysis becomes the surrogate for risk taking. It has been my experience that these management teams consist largely of financial, legal, management and marketing specialists and the same sorts of people are found in middle management as in top management. The analysis tasks are largely assigned to middle management where decision making consists of being able to hedge ones positions skillfully. Middle management has the least incentive for taking risks as well as the least capability for making technological assessments and judgements. Innovation which by its very nature is risky takes a back seat. The safe goal in life is to preserve the very comfortable status quo so innovation is effectively stifled and our large corporations have become notable for avoiding risk and thus innovation. This is all in spite of the fact that large corporations are in an extremely good position to take risks. In this context the data available showing the superior productivity and innovativeness of small companies and individuals as contrasted to large corporations is no surprise. Galbraith calls this whole syndrome "corporate senility" and makes suggestions for coping with it. In my opinion the only proven antidote for senility is activity and it applies to corporations just as well as it does to people. Innovation activity will reverse the corporate senility process and SBIR legislation could help to force that activity. The important thing to this committee however, concerning Galbraiths or any other realistic analysis of the situation is that they will all reach essentially the same conclusion. Further, this characterization of large corporations can be transposed almost directly to todays government agencies, research institutes and academia where most individuals are lost in the system so innovation infrequently surfaces. Only the application of massive resources brings new developments and those come at an extremely slow pace. The organizational structures inherently punish rather than reward risk taking. Without risk you are without innovation.

This character of corporate, academic and government bureaucracies is not a figment of someones imagination. It is real. To emphasize the reality, some of the experiences I have personally had with the system are related below. Before that a brief statement about my invention is necessary to try and provide the context for my experiences. The process chemistry I have developed facilitates small scale atmospheric pressure conversion of gaseous anhydrous ammonia fertilizer to a non-pressure ammonium nitrate fertilizer solution form. The increased value of the non-pressure fertilizer solution is well established so economic forecasts on the value of the process can be reasonably made. Additionally, a potential savings in total use of nitrogen fertilizer can be projected at 30%. Equivalent energy savings can thus be projected. Considering that each pound of anhydrous ammonia nitrogen represents the use of about 22,000 BTU's of natural gas for synthesis, the energy conservation implications are rather obvious. With this potential there was a great deal of interest in the process by a broad range of people that I tried to obtain help from after I exhausted all of my resources working on the project.

Large Corporations - These contacts included Emerson Electric, Whitaker Cable, Allied Chemical Co., Agrico, Occidental Petroleum, DuPont, Ingersoll Rand, Estech Chemical, Monsanto, International Minerals and Chemicals, Valmont Industries, DeKalb Ag. Res. Inc., Farmland Industries, Sperry New Holland, John Deere Co., International Harvester and many venture capital organizations. All of these companies expressed strong initial interest in the concept. I would then get assigned to talk to the legal staff or someone in middle management with a corporate development title of some sort. Many of the legal people made the decision that they would not evaluate the process on a confidential basis. These companies were usually doing business in this technology area. They consistently pointed out to me that their legal exposure was just too much for them to risk because they had so many people involved that they simply could not be responsible for them on confidential disclosure basis. They countered with a request that I sign a waiver of rights for them so they could evaluate. They would assure me verbally that they would not exploit me but a confidential disclosure agreement left them exposed to legal action by me if the process was exploited by an individual who might leave their employment and they did not have control over that. In short I was not able. to deal with them. If I talked to middle management first in the companies that were doing business in the technology area they approached the project from the standpoint that they already had a large R&D program in the area and knew some farmer could not discover something they didn't already know. It was the corporate NIH syndrome, not invented here. Ergo, risk taking is not a part of large corporation management. Companies not active in the technology area but interested in the economics generally agreed to a confidential disclosure. Their approach was one of lengthy analysis and then rejection of the project. The pattern was very consistent. They did not have the staff to make an adequate technical analysis. Analysis then was inconclusive, a surrogate for action. I was told repeatedly that if I had a unit in the field operating they could justify spending a lot of money because it looked good and it would then be a marketing project. In effect they were saying it would then be a short term business planning exercise. They understood and were comfortable with market development but not with product development. The obsession with short term rather than long term planning and development was ever evident.

Venture Capital- On the venture capital front I searched far and wide and found many sources of capital for market development but none for product development. Funds for development work simply were not available from entities that labeled themselves as venture capital organizations. They continually said it looks like a great project and just as soon as you get it in the market we can help you. Testimony before the House Science and Technology Oversight Committee on July 22, 1981 reinforces the fact that my experience was the norm and not a unique experience. The venture capital people at theose hearings could not cite one instance where development work had been funded by the so called venture capital people. Each and every project they invested in was at a later stage of development. The venture capital people are in reality very similar to the large corporation in their approach to new technology. I f you need a business plan we can help you but we do not become involved in development work. It is too long range in character. Venture capital for individuals and small businesses to fund development work does not exist in the so called venture capital market. In retrospect it is not surprising since it was my experience that the people running venture capital organization are cut from the same mold as large corporation management and in many cases are people drawn from corporate and financial institution staffs.

Government- When I attempted to obtain help from the government agencies that had R&D missions and grant programs in this technology area I encountered the strictest Webster definition of bureaucrats. Except for TVA I was told in each and every interview that my invention was a marvelous idea--BUT. At TVA I was told by the administration that the idea would never work and even if it would there was no way it would be practical. I was told by the technical staff later that the NIH syndrome was very real at TVA. I did receive some technical assistance from staff on a personal basis and was told if I did come to TVA for support on the project my chances of getting any as an individual were essentially nil. In those offices where my invention was a marvelous idea I heard one of two things. Either our charter doesn't fit or we can't work with individuals. In some offices the charter was close but they knew of another office that had more direct responsibility in this area. I spent several days in Washington and was actually referred back to some of the offices I had been sent from by people I was sent too. If that sounds confusing it is because it was. It was a vicious merry go round of passing the buck that was very difficult to believe even though it had just happened. I had the impression that no one in the agencies had responsibility for anything or at least they had all learned to rationalize that their was someone else that could handle your situation better if you were not with some institution they had done business with before. At NSF the charter did not fit because their definition of research excluded me. They made the judgement I was doing development work and they are restricted to support of basic research. As you and I both know, that judgement is a matter of perspective. It seems clear to me it was just another way of using our charter doesn't fit to avoid working with an individual. They did in fact tell me I would have better luck with a proposal if I would go back and develop a University affiliation. Several persons in DOE told me they were not set up to work with indiniduals. They also suggested I should return to be a professor or associate myself with a contracting organization they had already done business with and they could then support the project. At USDA they again could not work with me as an individual. I had a good idea and data, my credentials as a scientist were acceptable, but I as an individual was not a credible, or maybe comfortable, business entity to work with. Clearly our government does not have an effective means of fostering innovation by individuals. The bureaucracy has however established effective operational procedures for precluding access by most individuals to R&D grants and contracts. The agencies prefer to deal with other bureaucrats and have institutionalized the R&D system to the point where only large institutions (large corporation, universities, consulting firms and research institutes) can deal effectively with them. They have opted for minimum risk rather than maximum productivity at an acceptable level of risk. The safe thing is to preserve the status quo. Thus, except for the very small experimental OERI and NSF programs there is effectively no place for an individual innovator to go for government assistance and there is no place he can go and compete on a fair basis for R&D contracts. The NSF program is limited to basic research and OERI applicants must have projects with direct energy implications. Consequently, these two programs applicability to innovation in general is very limited and the funding level severely limits them as well. This is in spite of the well established fact that innovation stems largely from individual activity. The system clearly needs overhauling if the country is to gain the use of and benefit from the most valuable and productive resource the nation has for innovating, INDIVIDUALS.

What Can Be Done?

There is little likelihood that corporate philosophy and mode of operation will change for any reason other than necessity. Fear of market loss and thus demise of the corporation and consequent loss of their jobs is the only thing I have personally seen that causes management to innovate or allocate other than a nominal percent of resources towards innovation. Futher, it is evident that the only way the government bureaucracy will change is by force of legislative mandate. Goal setting and executive orders have been directed numerous times at the problem of R&D distribution and innovation with no results. The congress cannot change the corporate scene directly by mandate but they can mandate changes in government programs that will without doubt have effects on the corporate R&D scene. Congress must mandate changes in the government programs if it expects innovation to blossom and become the force it was historically and still can be in this country. Seed capital for development work must be provided by the government if individuals and small businesses, our best resource for innovation are to be effectively utilized. Tax policy programs and those sorts of incentives may mean something to the large corporations but they mean nothing to the true innovator who only has a dream. He needs help in terms of money and will worry about tax policy by hiring a lawyer and accountant once he is successful. At the idea development stage that is the fartherest thing from his mind. It is my opinion that an SBIR program that truly facilitates the involvement of individuals and small businesses in the innovation process in this country will have far reaching effects on the corporate R&D scene as well. As new products develop from support to innovation and enter the marketplace competition will force the corporate giants to take a new approach to R&D. The one thing the large corporations are capable of responding to is fear and when they are losing a market you will see R&D within that framework. It is my firm belief that pressure from new and improved products is the only thing that will bring this about and individual innovators as individuals and in small businesses are by far the best resource the country has to accomplish this. They have the ideas and technical competence but need seed money for R&D work. That sort of money is not available in any significant quantity from the private sector. We have advanced technologically to the place where the expense of R&D generally precludes the participation of an individual in the innovation process except as a part of an organization. The ideas for innovation still do and always will reside in the individual but as the situation now exists in our society there is no good vehicle for development of those ideas. A program such as the SBIR set aside legislation is a realistic approach to furnishing that money. Those individuals with an abundance of ideas are out there and a well designed program can reach them effectively. Once their ideas are nourished through the R&D stage there is plenty of capital, now called venture capital for market and manufacturing development activities.

Comments Concerning Positions By Opponents Of SBIR Set Aside Legislation

Academia-At the Science and Technology hearing of July 22, 1981 the position was advanced that an SBIR set aside would erode support for basic research. I presume the same position will be taken by the AAU representative testifying at these hearings. The contention is that the legislation would set aside a specific portion of an agencies basic research budget and that would then go to SBIR applicants so the funds would not go to basic research and further this would isolate the funds from open competition. This is as if to suggest the present system is one of open competition. The bias in current granting procedures is so overwhelmingly skewed towards institutions that one is amazed to see persons of scholarly background utter such a statement in public. This position also implies individuals are not capable of basic research conduct or ideas, which is completely contrary to the historical record. An SBIR set aside would only be a small dent in rectifying a long standing government R&D system bias that favors institutions dramatically in both the private and academic sectors. The experiences I related earlier testify to the extent of the bias and the data available on distribution of grants and R&D contracts just as vividly shows the pattern. The associated data on small business versus institutional productivity reinforces the need for a set aside if the government and the people of the country are to get their moneys worth out of government R&D dollars.

I would contend that an SBIR program modeled as projected on the NSF experimental program would provide rather than reduce funds available to Universities for basic research. The model program literature encourages the use of university personnel and facilities on a contract basis. Faculty will by virtue of the program be brought into contact with innovators and ideas will develop based on those contacts. Patents and products derived from those cooperative R&D activities will in many cases be jointly owned by the university and the innovator. Many major universities have active patent programs as well as research foundations to help commercialize discoveries. They have found such programs rewarding in terms of generating revenues which are plowed back in research and educational activities at the university. I have had personal experience with the Wisconsin Alumni Research Foundation and it is a tremendous resource for that University. Further, I am currently negotiating a contract with the University of Nebraska concerning patents which might arise from research I plan to conduct cooperatively with them in the technology area of my invention. We anticipate the contracts will result in revenue for the University as well as myself. A basic research project will also go forward in the University that would not have been pursued had I as an individual innovator not sought the university assistance. The NSF format definitely encourages this kind of interplay and there will be a great deal of it under an SBI R program. Innovators are intelligent enough to use the excellent help that can be obtained through a university. Realistically, the only way basic research could suffer as a result of an SBIR program would be if a particular university decided to stick their head in the sand and not participate. If that is the case that university is not in the main strean and should not receive basic research support from the government in the first place. It is very difficult to visualize how basic research at a good university could do anything but profit from an SBIR program.

Aside from generating revenue for research and education, I personally feel an SBIR program could do a great deal to stimulate university productivity. Universities as they exist today promote faculty primarily on the baisis of publishing scientific papers. Truly basic research is not a productive venture in those terms. Consequently , the bulk of the research conducted at universities is a hybrid of basic and applied research with a strong bias to the applied. It has been my experience working in a major university system as well as working cooperatively with faculty while in the private sector that studies on innovative ideas can fit very well into the university research format. Universities are a tremendous intellectual and physical facility resource. Their use needs to be encouraged in any SBIR program. Intelligent and aggressive use of university physical facilities will put an extremely costly part of R&D owrk at the disposal of individual innovators for a very minimal price. The intellectual resource will come with it and the innovator and university will both benefit. Faculty members in general get very excited and productive when involved in programs to develop basic knowledge or a combination of basic and applied knowledge for application to the solution of a specific problem. I have found them to be much more productive when an application goal is in sight as contrasted to the normal publish 2 papers this year routine. A further aspect of SBIR involvement with the universities is that graduate students are the best source of technical labor that can be found anywhere. They will by necessity be doing much of the cooperative university-SBIR innovator project work and thus will be intimately exposed to the innovation process as well as to the basic research philosophy of the university. That exposure should be a valuable component of the education received by the graduate student and I think will bode well for the future of technological innovation in this country. Experience is still by far the best teacher mankind has ever known. There is no substitute for it. Graduate students, the technologists of tommorrow, will have a chance at innovation education through experience.

The university association lobbyists have made the point that all of the set aside funds might, at the agencies discretion, come from the basic research side of the agencies budget. That is a legitimate concern and should be specifically addressed by the legislation or the regulations concerning it.

In summary, academia should benefit, not suffer from well designed SBIR set aside legislation. "The Unfettered Sifting and Winnowing of Knowledge", as basic research is often called in the Halls of Ivy is not incompatible with but will benefit from SBIR set aside legislation.

Government Agencies- The refrain heard at the Science and Technology hearing on an SBIR set aside and technological innovation as well as in conversation with agency people is consistently that the objective of the SBIR set aside is a good and honorable objective but the set aside is not the way to implement it. Four major arguments surface in any dialogue with them.

The first is that a set aside would take an agencies flexibility to manage their programs away from them. They can not be effective managers if they are told what to do. They suggest a goal program on small business involvement instead of the set aside. The simple fact is that the goal programs have been tried repeatedly by congress and the executive branch. They have not worked. The agencies prefer to work with the large corporations and institutions because it is a known thing to them, easy and they do not have to take any risk in the judgement making process even though it is more expensive and less productive than working with small business. Legislative mandate is the only way congress can be assured of getting small business involvement.

The second argument is that technology transfer programs should be pushed as a more productive way to spend money in innovation than an SBIR program. The position advanced by SBA is that technology transfer programs reach many more people than a program such as an SBIR will at a far smaller cost per client. The fact that an agency can be that short sighted should convince congress even more of the need for SBIR legislation. It shows clearly the agency does not understand the innovation process and needs to be told what to do. The question that SBIR addresses and the agencies need to address is not whether and how you want to disseminate information on technology but one of how do you stimulate technological innovation. One answer is an SBIR program. Information retrieval systems abound in our society. They are available through all major libraries and universities. Persons and firms with technology capabilities are quite aware of the services, their capability and the low cost of using them. Those truly interested in innovation gain nothing from the technology transfer programs they do not already have access to. Cataloging and publishing of information can be a legitimate function of agencies but to spend money and effort on the technology transfer program such as for example SBA is pushing is a waste of time and money. The true innovators do not wait for the information to come from an agency but find it on their own far ahead of the normal lag of coming through a technology transfer program. This will be especially true of high technology innovators. The old adage of you can lead a horse to water but you can't make him drink applies directly to technology transfer programs and innovation. Most of the information distributed by those programs will find an inactive bookshelf or a waste basket as the repository. The horse that did not seek the water in the first place very seldom drinks. Information is available now through the existing information retrieval systems. It can and will be obtained readily by those persons who are capable of technological innovation without a technology transfer program that is being touted as a substitute for an SBIR program. Development money, not information is the missing factor for innovation. It appears that the agencies want a technology transfer program because they either do not understand the nature of technological innovation or they are more comfortable with instituting another internally controlled program that will enlarge the internal bureaucracy and keep them from being involved in the real world of individuals, small businesses and innovation. An SBIR program involves making judgements and that has a connotation of risk whereas technology transfer involves setting up a computerized mailing list, something they are comfortable with and can say we sent out 5,000 mailings this month. You must mandate an SBIR set aside.

A third argument is that the evaluation process in an SBIR program would be too difficult to manage effectively. That can only be construed as an excuse to not do something. The evaluation program in itself can do a great deal to stimulate innovation in the technology community if it is well designed and run. The agency administrators view it as risky to try and develop and manage something they do not have a lot of experience with. Risk is something they are against without even realizing it because of the very nature of their bureaucracies. Risk however is necessary for innovation. The fact is that there is good experience in government with an SBIR type program. Roland Tibbits and his staff at NSF have extremely valuable and effective experience from their experimental program which can be called on when working with the top end of the technology end of the innovator spectrum. George Lewett and his staff in the OERI program have a wealth of experience and worked out a program for working with innovators accross the whole spectrum of technological competence. Aside from these two programs the Butte, Montana Center For Innovation has accumulated valuable experience in working with innovators accross the spectrum using the concept of developing a partnership with the innovators. Aspects of that have been successful and can be effectively incorporated and used along with the experiences of the NSF and OERI programs in the design of the SBIR program. There is adequate experience to use as a base for establishing an effective program to evaluate and administer a program on the broad range of proposals an SBIR program is sure to receive. That argument should not be allowed to prevail as an excuse for maintaining the status quo.

The fourth argument advanced by the agencies is that we are now committed to a free enterprise market oriented system in which government is not to be an influence. They state, business innovation and development work and the financing thereof are the proper domain of the private sector. The capital needs for innovation work will flow from the private sector based on sound business investment decisions and the entreprenurial spirit of America. In the offices of the agencies and OSTP and in the parlance of textbooks on economics and free enterprise this is a grand and glorious concept as well as a noble pronouncement. It only needs to be preceeded by HEAR YE HEAR YE. In todays United States, the real world it is ridiculous. It has to be characterized as being either extremely naive or extremely self serving. In either case it is a do nothing approach. Leave the technological innovation problem alone and it will go away is the course of action. Capital for development work by small business and individuals is not available in any significant quantity from the private sector. It is available only for market development work. The real fact is that technology is advancing at a frightening pace in the eyes of the non-technical individual in the private sector who might have financed development work 20 years ago when he understood everything a lot better. He is now going to invest his money in a high yield money market fund. Frand has pointed out that historically we could view technological innovation cycles in terms of 20 years. Now a cycle can realistically be viewed as taking 3 to 5 years. With that kind of turnover in technology, judgements and investments are risky. The investor from the private sector looks for the high assured yields on his money and protects it rather than risks it. The individual with the high technology capabilities very seldom has financial resources to risk. Thus, funding an individuals innovative ideas at the development stages is seldom achieved outside of an institution in the private sector. When a project gets to the market development stage, that represents short term planning and money is available because the investor understands it. As noted before the cost of facilities and equipment for doing R&D is so great in todays world of high technology that it is generally out of the reach of individuals and small businesses, the innovators. SBIR legislation could provide money for them to gain access to university facilities. Again, the realities of the venture capital market are that essentially none is available from the private sector to support R&D by individuals and small businesses.

Concerning the matter of no government influence on R&D in the private sector, it is truly amazing to hear such a statement. Government is so intimately involved in the large corporation R&D in this country that it is impossible for government to not influence it. The only way would be for the government to stop R&D funding. Virtually every major company R&D program in the country is based on, intertwined with and funded by government R&D objectives and money. Those who do not think so need only to visit a few of those R&D facilities and they will very quidkly realize the influence of government on private sector R&D. The question then is not one of government influence on the "free enterprise" system and private sector R&D, but one of policy on the manner in which that influence is rendered. Government agencies have demonstrated that the goal setting and executive order approaches to involving small business in R&D do not work. By their own studies they have just as clearly demonstrated that small business is infinitely more productive than large corporations in most R&D work and much superior in innovativeness. The SBIR legislation objective is and should be to stimulate innovation. It should not be perceived as favoring small business or a threat to the free enterprise system. Individuals and small businesses and particularly individuals in small businesses are definitely the best resource and vehicle the country has to bring about innovation. The SBIR legislation will be for the United States, not small business and it should be advanced in that light. The agencies SHOULD NOT BE ALLOWED TO CONTINUE LETTING WHAT THEY THINK THEY KNOW KEEP THEM FROM LEARNING. They need to be saved from themselves.

Benifits Of An SBIR Program Other Than Grants

The potential availability of funds to individuals and small businesses will foster serious consideration of idea development from large numbers of people that would not have considered developing an idea because of financial limitations. Preparation of a proposal requires structuring the concept and as the innovator goes through that formal definition and structuring process he will frequently gain new insights. Thus the very existence of an SBIR program will in all likelihood stimulate innovation even if a grant is not awarded. The individual will have taken a step in the innovation process that he would not have taken otherwise. The true innovator will pursue the problem or an

In the review process for an SBIR program many individuals will be exposed to the SBIR program as reviewers. Those persons by necessity will have technical backgrounds. Many will have innovative tendencies which have not been developed because there is currently very little potential in our system for them to develop an idea. They have been comfortable as scientists and although intrigued at times with innovative ideas, not willing to risk their own resources to develop the idea. The institutional system they currently exist in will likewise not pursue their ideas. A significant number of these people will make their own SBIR proposals once they have been exposed to the system through the review process. Some of the best technology minds in the country will be brought into the innovation process because they will learn that a format for them to participate exists. They only need exposure.

The benefits to universities and to innovation education were discussed earlier and in my estimation will be very significant.

SBIR grants and contracts will pay off in the form of new products and processes and improvements on old ones. As this happens competition will force the large companies to reconsider their attitudes on innovation. Hopefully this will lead to them allocating more resources to R&D and we will see revitalization of American industry.

APPENDIX II

APPENDIX II

SUPPLEMENTARY STATEMENT
OF RICHARD REED
TO THE HOUSE SUB-COMMITTEE
ON INVESTIGATIONS & OVERSIGHT

Based upon my dealings with OERI and my analysis of the first 175 ideas recommended by OERI, it is obvious that OERI has not filled the void for which Congress intended it. Rather, a clear and strong inference can be drawn from my experience with OERI and my analysis of the ideas which it has approved, namely that the ideas which have found favor with OERI are ideas which either already had development commitments from established industries or which if developed would avoid inconveniencing or embarrasing established industries. The net effect of this is that the ideas which have received support from OERI are the same ideas which would have been developed by established industry had OERI never existed.

On the basis of my experience with OERI, it is obvious that OERI's policy is to withhold as much information from the inventors about the evaluation of their ideas as possible. Although I have received three rejection letters, none contain any technical information that indicates how the "evaluator" arrived at his conclusions. After a series of "Freedom of Information" requests and appeals, OERI has still refused to allow me to see what they have in my file, even after I agreed to the deletion of all names of the reviewers and evaluators. It is ironic indeed that, on the one hand, un-named reviewers, either with OERI or drawn from the private sector, have access to the complete description and all illustrations of my idea, while I, on the other hand, am not even allowed to know what they discovered in the evaluation process.

After completing OERI's submission form #1019 on October 15, 1978, I received an acknowledgement dated October 23, 1978 and a notice of acceptance to first stage evaluation dated October 26, 1978. OERI made no contacts with me either by letter or by phone for the next four months.

The initial rejection letter dated February 23, 1979 contained no technical information whatsoever. In fact, the only reference to the evaluation of my idea was contained in two sentences: "The evaluation of your engine design indicates deficiencies relative to pollution emission. It is overly complex mechanically and would seem to offer no advantage in energy conservation."

A second rejection letter dated July 19, 1979, like the first, failed to address the seven contentions contained in my submission. Although my second request for reconsideration was mailed September 4, 1979 it was October 29, 1979 before I received a form acknowledgement letter.

The other thing that concerned me about OERI's posture in dealing with me was their obstinate position against discussing technical bases for their conclusions. During my second conversation with evaluator Weiser, I asked if I could see whatever technical information that was in my file if I came to Washington. Weiser replied that this information was not subject to the freedom of information act and that in his words "God himself would not be allowed to see this information." Weiser reasoned as did Coultas that reviewers would be very reluctant to express frank opinions if they knew their names might be released. I would make two observations about this. One, the awareness of reviewers that they possibly might be confronted with having to justify their conclusions, would place greater presure on them to carry out their evaluations in such a way that they could support their findings or conclusions with technical facts and figures. And two, the deletion of the name or names of such reviewers should attend to any fear of being harrassed.

My analysis of the first 175 ideas recommended by OERI is based on the information contained in Attachment #2 of OERI Chief George Lewett's statement to the House Committee on Science and Technology. Although there are some information voids in this report and although some calculations may contain slight errors, neither of these factors will alter any conclusions to any significant degree. My analysis will show that OERI has maintained a strong bias in favor of established companies over individuals in every meaningful measurement. Although Mr. Lewett claims that most of these companies are small companies, employing 100 or fewer employees, he furnished no data to support that claim. My analysis will show that OERI has maintained a strong bias in favor of ideas that are in the final development stages over ideas in the earlier conceptual stages or pre-prototype stages. It appears that either the evaluators and reviewers do not possess the knowledge to apply the test of mathematics, physics, and chemistry to a well defined idea which has not actually been built, or that they do not have faith in the reliability of these technologies. My analysis will establish that OERI has favored ideas submitted that are within the submitter's product line or ability to produce, or that involve industrial processes relating to the submitter's type of industry, over ideas submitted by an individual who has no such advantages. Paradoxically, the main purpose of the program is to capture and develop ideas conceived by those who lack the resources to follow through on their ideas.

My analysis will establish that OERI's slow response time is not justified on the basis of the number of ideas being submitted. When taking into account the resources at the disposal of OERI, a strong case can be made that there is so much bureaucratic machinery involved in its operations that it would be impossible to jsutify for a task of evaluating an average of approximately 6 ideas a day. And finally my analysis will show that OERI has committed the bulk of its resources to performing bureaucratic massages, composing ambiguous and meaningless response letters and to building a bureaucratic empire rather than performing thorough and meaningful evaluations.

OERI's bias in favor of companies over individuals is likely much stronger than the available statistics will show. Mr. Lewett's statement does not tell the ratio of individual submissions to company submissions contained in the first 16,780 submissions, nor does it reveal that ratio on ideas which are advanced to first or second stage evaluations. Nevertheless, Attachment #2 does reveal that out of the first 175 recommendations 104 or 59.4% are company submissions and 71 or 40.6% are individual submissions.

It is also interesting to note that the response time for the company recommendations is significantly shorter than the response time for individuals. Response time is defined as the time that elapses between receipt of form #1019 and a recommendation to DOE. For the entire 104 company submissions, the response time for companies averages 16.4 months against a response time for individual submissions of 17.7 months. When eliminating the 13 submissions that took greater than 30 months response time, the company response time averages 14.4 months for 95 submissions and the individual response time averages 16.7 months. During the first thirty months of the program, April 1975 to October 1977, during which time a total of 100 recommendations were made, the response time was even more favorable to companies over individuals. For the first 63 company ideas, the response time averaged 17.6 months, while the response time for the 37 individual ideas averaged 20.2 months.

When moving to those ideas which have been awarded grants, the bias in favor of companies over individuals increases. Out of the 104 companies which were recommended 61 or 58.7% received grants, while 23 out of 71 individuals recommended; that is 32.4% of the 71 individuals received grants. Thus 72.6% of the 84 grants went to companies, while 27.4% went to individuals. When comparing the grant amounts, the bias again favors the companies. Of the $6,146,891 in grant money awarded, $4,708,455 or 76.6% went to companies while $1,438,436 or 23.4% went to individuals. The average grant for companies was $77,177 while the average grant for individuals was $62,541.

It is interesting that OERI recommends and DOE funds a higher percentage of ideas that are in the final development stages than ideas that are in the pre-prototype stages and awards the larger grants to those in the final development stages. Of the 175 ideas which OERI has recommended to DOE, only 35 recommendations were for concept development and only 22 recommendations were for prototype development. This means that only 57 of the 175 ideas recommended or 32.6 percent were recommended at pre-prototype stages at which time the greater assistance is needed. Of the 84 ideas receiving funding from DOE, only 16 pre-prototype awards, that is 19% have received approval.

The bias in favor of companies over individuals is also evident with pre-prototype grants. Ten (or 62.5%) of the pre-prototype awards went to companies, while 6 (or37.5%) of such awards went to individuals. The average size of the pre-prototype awards to companies is $71,516, while it is $54,199 for individuals. The average for all 16 pre-prototype awards is $65,022 compared to an average of $75,096 for all ideas at or beyond the prototype stage. In terms of total award money, only $1,040,355 was awarded for pre-prototype ideas, while $5,106,536 was awarded for ideas at or beyond the prototype stage. It is most paradoxical that only 17% of the total award money and 19% of the total number of awards have gone to fund ideas at stages where the risks are high and the needs are great, while 83% of all award money and 81% of all awards have gone to fund ideas at later stages when the risks are lower and at a time when a great portion of the funding needs have already been satisfied.

Both in terms of recommendations and awards, company-submitted ideas, which relate to one of their industrial processes or which are within their product lines, or within their ability to produce, are favored over ideas submitted by inventors who invent out of their field, or who lack the resources to develop and produce their ideas. Establishing an exact ratio in this case is not possible because the description of the ideas and the nature of the companies business are not always adequately defined. However, among the 104 companies, the names of 87 companies indicate their involvment in the industrial process related to ideas submitted or the manufacturing of products related to the ideas submitted. In 13 recommendations involving companies, the companies merely bear the name of the inventor and give no clue as to the nature of their operations. In the remaining 4 company recommendations, there are no clues as to the nature of the companies operations. This means that no less than 49.7% off all OERI recommendations involve companies submitting ideas that relate to their operations or their product line, or ideas that are withen their ability to produce. Forty three companies in this category were funded for a total of $3,249,211 or an average of $75,563 per award. It is also interesting to note that 7 out of 11 ideas which received grants over $100,000 were company ideas in this category.

OERI received 16,780 submissions from the start of the program in April of 1975 through March 31, 1981. Removing the 8505 submissions which were not accepted for 1st stage evaluation, this leaves only 8,275 which required evaluation. Dividing this figure by the number of months during this period (72), this means OERI has referred an average of 115 ideas a month to first stage evaluation. This figures out to approximately 5.5 evaluations per work-day. Each 1st stage evaluation, according to OERI's "Synopsis of Evaluation Process" form #LC1092, requires an estimated one half to eight man hours.

Dividing the 648 ideas which reached 2nd stage by 72 months leaves only 9 ideas a month for 2nd stage evaluation. According to OERI "Synopsis of Evaluation Process" 2nd stage evaluations require between one and forty man days. Using the median time for 1st stage evaluations of 4¼ hours per evaluation and the median time for second stage evaluations of 70 hours, the total man hours per month would be 488 man hours for first stage evaluations and 630 man hours for second stage evaluations for a total of 1118 man hours per month. Using 168 man hours per month, per full-time employee, OERI's 10 full-time professional employees alone should make 1680 man hours per month available to carry out OERI's tasks. This does not take into consideration the time of the six full-time and six part-time clerks, the two part-time evaluators, or the 300 or so outside consultants and evaluators.

The Second distinct pattern, common to my own experience with OERI and my analysis or OERI's recommendations concerns the intensity to which OERI defends established industry. Nowhere is this more evident than where an idea relates to the automobile industry. In case of my idea, an internal combustion engine, I never mentioned motor vehicle, automobile, or anything related in my submission or any of my follow-up requests. Yet in every exchange with OERI officials following the first rejection letter, OERI officials have moved to the defense of the auto industry.

OERI's defense of the auto industry is equally evident concerning the ideas they have chosen to recommend. Ten ideas in the "Internal Combustion Engine and Components" category have been recommended OERI, out of which a possible fourteen have any real relationship to energy consumption where the auto industry is concerned. (Note #96 should have been assigned to the Industrial Process or Miscellaneous Category)

Ideas #31, #48, #52, #99 and #147 are not related to automobiles. Idea #133 related more to passenger comfort than to energy consumption and involves no technology new to the auto industry. Idea #114 related specifically to the tire industry and attacks energy consumption in an area where little can be gained.

Idea #5 the conversion of gasoline engines to diesel engines accomplished nothing that merely switching from a gasoline engine to a diesel engine would not accomplish and given the need for the stronger construction for diesel engines, the reliability of such process is very doubtful.

Idea #131 proposes to do what General Motors in fact is already doing with the 4-6-8 cadillac. However, according to most reports, very little energy is saved and the maintenance problems are so great that the marginal energy savings are more than offset by maintenance costs. Ideas #54 and #58 involve improved ignition systems. Ideas #6, #50, #69, #101 and #122 are proposals which involve the metering and mixing of fuel with air and idea #13 proposes a system which would capture and recycle unburned fuel. The real limiting factor relating to these 8 ideas, considering that they will in fact work, is that none of these ideas or any combination thereof ideas can save more fuel that the 2% to 3% which the more efficient conventional automobile engines fail to burn industry. In the case of my idea, an internal combustion engine, I never mentioned motor vehicle, automobile, or anything related in my submission or any of my follow-up requests. Yet in every exchange with OERI officials following the first rejection letter, OERI officials have moved to the defense of the auto industry. Evaluator Coultas injected a defense of the automobile industry in his March 5, 1979 conversation with me as did Sidney Weiser in his June 18, 1979 conversation with me and George Lewett in his response to Congressman Frost and in his July 8, 1980 rejection letter to me.

OERI's defense of the auto industry is equally evident concerning the ideas they have chosen to recommend. Ten ideas in the "Internal Combustion Engine and Components" category and 11 ideas in the "Transportation Systems, Vehicles and Components" category have been recommended by OERI, out of which a possible fourteen have any real relationship to energy consumption where the auto industry is concerned. (Note #96 should have been assigned to the Industrial Process or Miscellaneous Category)

Ideas #31, #48, #52, #99 and #147 are not related to automobiles. Idea #133 relates more to passenger comfort than to energy consumption and involves no technology new to the auto industry. Idea #114 relates specifically to the tire industry and attacks energy consumption in an area where little can be gained. Idea #5 the conversion of gasoline engines to diesel engines accomplishes nothing that merely switching from a gasoline engine to a diesel engine would not accomplish, and given the need for the stronger construction for diesel engines, the reliability of such process is very doubtful.

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Idea #152, an idea which accelerates the warm-up period of the engine does target a problem involving some waste of fuel. However, this idea, if it works, can only result in significant energy savings involving the short trip use of automobiles. The remaining three ideas #8, #141 and #164 apparently are devices which capture some of the wasted momentum in stop and go driving. Of all the ideas recommended by OERI, the momentum capturing ideas are the only ideas which conceivably might embarrass or inconvenience the automobile industry.

Because of the automobile industries negative attitude toward innovation, the industry probably will continue to be embarrassed. However, the industry will not be embarrassed by inventions which focus on some sort of gas leaning devices, ignition devices, gas line regulator devices etc.. The reason these approaches are doomed to mediocre improvement in fuel consumption is that you simply cannot accomplish savings in any area that exceeds the amount which is being wasted. All devices in these three areas target the final 2 or 3% of fuel which is being wasted by the more efficient engines in these areas.

The third pattern common to both my experience with OERI and my analysis of OERI's first 175 recommendations regards OERI's determination to avoid taking risks. OERI elects to recommend and DOE choosed to fund no risk or low risk ideas which are only marginally promising with respect to energy, over higher risk ideas which are highly promising with respect to energy. To illustrate, OERI recommended 14 ideas relating to motor vehicles of which only 4 fall in categories where there is significant room for improvement in fuel consumption. Of the 4 ideas that fall in categories where there is significant room for improvement in fuel consumption, not one has been funded by DOE. In contrast, 8 out of 10 of the ideas which fall into the marginal fuels saving category have been funded for a total of $540,076 .

My final observation about what my experience with OERI and my analysis of OERI's recommendations combine to tell is that their decision making process simply has not produced the results that Congress intended. During the first six years of OERI's operations, approximately three dollars were spent on the program for every one dollar awarded. During OERI's first six years, they were only able to recommend a total of 23 ideas submitted by individual inventors which DOE found worthy of funding. During OERI's first six years, during which period of time 16,780 ideas were submitted, OERI only managed to discover a total of 84 ideas that DOE found worthy of funding. And although there are some ideas which have been funded and some ideas awaiting funding under this program which will produce positive energy results, there have been no significant breakthroughs with respect to either energy conservation or energy production when applied to this nations overall energy consumption and production.

Although the first six years of OERI's existence have produced only very mediocre results and at overwhelming costs in terms of tax dollars spent on the program, there is a real need for such a program. And I am convienced that such a program can be made work as Congress intended. I have several recommendations which I think if adopted, will contribute to making the program function as Congress intended.

The policy of OERI should be to award a maximum amount of information to the inventor, rather than a minimum of information. Both the strong and the weak points should be shared with the inventor. In the case of ideas which present new and interesting designs, but which may have one or more technical flaws, the response to the inventor should acknowledge the strong points and identify the flaws, rather than merely rejecting the idea. The information which goes back to the inventor should be specific and should be written in terms that the submitter would be calculated to understand. Often, it is less time consuming and easier to be specific and understandable than it is to be vague and unclear.

The evaluation process ought to focus on the front-end, rather than the back-end of the development process. Mathematics, physics, and chemistry are predictable and consistent. An idea's performance can be calculated before the idea has been built, if the evaluator has the expertise. This is the area in which the independent inventor needs the most assistance. And this is where OERI stands the greatest chance of discovering a really meaningful energy related idea.

Finally, a policy decision should be spelled out, which targets the independent inventor for the major portion of OERI's program assistance rather than companies, small or large which possess the resources to develop their ideas without such assistance. Part of the submission form should describe the resources which the submitter has available and the specific assistance which is needed. One of the responsibilities of the evaluator should be to make a decision as to whether or not OERI's program assistance is actually needed.

In summary, the first 6½ years of OERI's existance has failed to produce a significant breakthrough with respect to either energy conservation or energy production. Nevertheless, a program of this type is much needed and given strong leadership and the proper Congressional guidance, such a program can furnish the kind of assistance to independent inventors and small companies that will result in meaningful innovation relating to energy.

Ewell Richard Reed

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APPENDIX III

Comments by George P. Lewett, Chief, Office of Energy-Related Inventions (OERI)
On
Supplementary Statement of Richard Reed, Independent Inventor,
To The
House SubCommittee on Investigations and Oversight
November 27, 1981

Mr. Reed's statement makes three basic allegations:

1. Information feedback from the evaluation process to the inventor is inadequate.
2. Program results indicate bias towards companies and established industries and against the individual and independent inventor.
3. Performance has been inefficient and ineffective.

These allegations are addressed in Section I, II, and III below. The statement also includes several recommendations. I comment on these in Section IV.

I. Information Feedback From the Evaluation Process

The enabling legislation, as interpreted by the National Bureau of Standards, postulates that the primary purpose of the Energy-Related Inventions Program is to discover and support development and commercialization of new energy-related technology which would not otherwise be supported because it originated with an independent inventor or very small business. The premise was that the independent inventor and small businesses did not have the access to Government support sources which was available to large firms; and, therefore, technology of value in the energy areas would be lost to the nation or would be significantly delayed in making its potential contribution.

In planning to implement the Congressional mandate, annual resources on the order of $1.75 million were estimated as required to perform the invention evaluation function.

While many subordinate purposes and objectives were established in designing the Program, it was clear that the primary focus had to be on technology identification and support. Derivative benefits to inventors, or improvement of the inventor's capabilities and output of the independent inventor/small business sector, were secondary issues to be addressed only as resources would permit. While the Program provides assistance to independent inventors as a by-product, it was not designed or intended to be an inventor-assistance program.

The evaluation process is aimed at coming to a decision on the technology with minimum expenditure of resources and with minimum chance of missing a worthwhile invention. OERI policy is to maximize information feedback to inventors, subject to the constraint that resource allocation is determined by what is required to come to a decision on the technology.

Whatever information is developed in the evaluation process, which could be of value to the inventor, is passed on to him. However, we find that in very few cases does such information constitute a complete technical critique. In many cases the amount of information passed on is quite limited. Mr. Reed's internal combustion design was only one of some 450 engine designs submitted for evaluation. In each of these we would have liked to point out everything that was right and wrong about the design, but this type of consultant service is not possible within the resources allowed.

In keeping with the aim of not missing a good invention, an open appeal process is featured in evaluation: as long as an inventor questions the OERI decision and submits further data, his file is kept open and the invention continually reevaluated. This feature has proved to be of value. Our records show that 10-15% of OERI-recommended inventions were rejected initially but were recommended after reevaluation. In the process of appeal and reevaluation, the inventor of course receives additional information about his invention.

The amount of information passed on to the inventor as a by-product of the evaluation varies considerably case-by-case. Mr. Reed's comments reflect one inventor's experience; in many cases inventors have indicated that the information received has been of significant benefit.

Mr. Reed indicates concern that he was not given access to the written comments provided by consultant reviewers even after a series of

Freedom of Information Act requests and appeals. In our view this concern is not justified; the substantive information in the comments has been passed on to him, either, by letter or in telephone discussions.

In concluding, I would like to point out that Mr. Reed's case was reviewed by the Inspector General's Office in the Department of Commerce at the request of Congressman Frost. The Inspector General who had access to all files including the reviewer results, concluded that the case was equitably and fairly handled by OERI.

II. Bias in the Evaluation and Support Process

Mr. Reed's comments in this category are based on analysis of the list of recommended inventions provided in my submitted testimony. Further information is provided here in Figure 1, Section A, with respect to results by stage of development of inventions evaluated and recommended. The stages of invention development listed are those shown in the Evaluation Request Form (NBS-1019) and the data given were provided on the application form when the inventions were submitted.

It is certainly true that most of the recommended inventions are in latter stages of development (75% past Laboratory Experimentation; 40% past Prototype Development; and 26.7% in at least Limited Production and Marketing). I cannot, however, agree with Mr. Reed's interpretation. The data shown simply reflect the realities of the innovation process and are characteristic of the entire population of all new ideas at a particular point in time; the data of Figure 1 actually make a good case for the reliability of the OERI evaluation process. Given 100 ideas in the Concept Definition stage and 100 at the Production Engineering stage for example, it is to be expected that more of those at the later stage are likely to be successful than those at the earlier stage. The evaluation process looks at the intrinsic merit of an invention. A focus on earlier-stage-of-development ideas would not change the fact of a higher fall-out rate at an earlier stage, as it occurs not only in the Program but also in evaluations performed in the private sector and in the marketplace.

The data used by Mr. Reed and the data presented in Figure 1 may not be consistent. The Figure 1 data represent the stage of invention when submitted for evaluation. The data used by Mr. Reed represent the stage after recommendation and in the process of being supported.

Statistics on the number of individuals and companies submitting inventions are also available from information provided on the Evaluation Request form as shown in Section B of Figure 1. The data indicate that the major users of the program are individuals and that individuals are being successful in obtaining recommendations and grants.

Mr. Reed's calculation, which indicates that the list of recommendations is made up of 59.4% company submissions and 40.6% individual submissions, differs significantly from the data of Figure 1B. The difference is, however, understandable since the list of recommendations did not provide significant detail to support Mr. Reed's analysis; the number of employees per company was not given, and in many companies participating in the program the inventor is the only employee. Also, the status frequently changes after submission of the Evaluation Request; a frequent outcome of a recommendation is that the inventor forms a company.

I do not believe the statistics or Mr. Reed's analysis support a finding of "bias" against the independent inventor. They do show that individual inventors are our principal constituency, particularly when we note that the bulk of the companies counted are companies in which a previously-independent inventor is a principal. Reflection on material provided elsewhere in my testimony at this Hearing should show that the program is designed and operates with particular attention to the needs of that constituency. Nevertheless, regardless of the needs of the inventor, his qualifications, or his personal characteristics, the evaluation focuses on, and decisions are made solely on, the basis of the technology. We may and do sympathize with the difficult task of the independent inventor, but the governing policy is that Government support is warranted only where the technology is seen to have significant potential value. In effect, the Program assures that the independent inventor will be heard and fairly dealt with. The evaluation process is designed to be completely objective in examining the technology; it is biased neither for nor against an individual or company.

A. Invention Stage of Development (6/1/78-11/1/78)

Stage of Invention Development	Cumulative % of Total Inventions			Actual % Recommended
	All Evaluated	Reaching 2nd Stage	Recommended	
Concept Definition	17.4	5.6	3.3	3.3
Concept Development	43.3*	23.5	18.3	15.0
Laboratory Test	47.1	29.1	25.0	6.7
Engineering Design	56.7	45.0	35.0	10.0
Working Model	71.3	55.8	45.0	10.0
Prototype Development	78.7	65.1	60.0	15.0
Prototype Test	89.0	82.0*	70.0	10.0
Production Engineering	91.0	85.6	73.3	13.3
Limited Production & Marketing	96.5	94.9	96.7*	23.4*
Production and Marketing	100.0	100.0	100.0	3.3
Total Inventions in Category**	4332	195	60	60

*Stage with largest number of inventions (mode)

B. Size of Company Involved (6/1/78-11/30/78)

Number of Employees	% of Inventions		
	All Evaluated	Reaching 2nd Stage	Recommended
0 - 1	90.6	77.2	76.9
2 - 20	7.9	19.1	18.5
21 - 100	1.0	2.2	1.5
> 100	.5	1.5	3.1
Total Inventions in Category**	4684	272	65

**Inventions for which data had been entered on NBS 1019 Form by inventor.

FIGURE 1. OERI Statistics From Evaluation Request Forms

III. Performance

Mr. Reed questions the value of the inventions recommended and implies that performance as measured by response time and application of resources has been inefficient. We feel the allegations are not well founded. The Program is a complex one and is sufficiently unique that there is no proper basis for comparison; data to assess the values of the recommendations, or performance relative to program benefits, are not available.

A program evaluation effort is underway and we are certain that, when completed, it will show that benefits deriving from the program in terms of energy savings, as well as economic and societial benefits, will be substantial and well worth program cost. The initial part of this evaluation effort - case studies of 30 recommended and supported inventions - will be available by the end of the calendar year 1981. A review of some supported inventions was reported in the MIT Technology Review in December 1979. The article is a principal basis for our projection of significant program value noted above - a copy of the article is provided as Attachment 1.

Response time -- the time to process an evaluation request and notify the inventor of the results - has always been subject to criticism as being too slow. The time has improved steadily since the beginning of the program, (as noted in other testimony), to the point where the average for evaluated inventions now approximates 20 weeks. It should be noted, however, that response times for individual inventions have varied considerably. Principal factors involved are: poor presentation by the inventor of his idea, necessitating frequent information additions, resubmission after rejection, and extensive dialogue with evaluators; difficulty in finding consultant evaluators where technology is unusual or the invention very complex; and irregular flow as input volume varies sharply with political and other conditions.

In assessing response time, generally "slowness" is intrinsic to the design of the evaluation process. Our emphasis is now on not missing a good invention and on assuring objectivity. A Program expansion to minimize response time would involve trade-offs against these two factors which are of primary importance.

There is a tendency to compare the Program with other more conventional grant programs which are aimed at small businesses. The point that the Program is different and unique has been made before. To the best of our knowledge, we know of no other program which would accept Mr. Reed's invention for consideration, nor is there any other source within the Federal Government which would provide the information he received as a result of his participation in the Inventions Program.

Mr. Reed's analysis of OERI workload and manpower is not accurate. Evaluation time requirements noted in the "Synopsis of Evaluation Process" cover only consultant time. In First-Stage evaluation there are multiple consultant reviews (average of 2 reviews per evaluation). An OERI staff evaluator reviews each invention, and the consultant input when available, more than once; and the decision-making function he performs, particularly in Second-Stage evaluation, is not a trivial, but frequently a time-consuming, one. Some 15-20% of inventions are appealed and additional review by both consultants and OERI staff evaluators is required. In addition to evaluations, OERI staff also deal with a separate correspondence workload which has ranged from 600-1500 items per month, including a significant amount of Congressional correspondence.

Averages calculated from the "broad-brush" data which Mr. Reed uses are misleading. OERI effort and program costs associated with inventions vary considerably. OERI expenditures on an individual item turned down in first-stage evaluation, for example, may range from some $400 up to as much as $1500. While the bulk of inventions evaluated at that stage may cost in the order of $400, a case such as Mr. Reed's, where reevaluation effort, associated correspondence, and contacts with the inventor and other agencies are extensive, required significantly high resource expenditures.

Mr. Reed's statement that "approximately three dollars were spent on the program for every one dollar awarded" implies that the only measure of value of the program is the number of grants awarded. In other submitted testimony, I pointed out that some 8200 evaluation reports had been forwarded as part of Program output to individual inventors and small companies. There have been indications, to be verified in the program evaluation effort mentioned earlier as under way, that evaluation reports have significant value in themselves; a number of the supported inventors have stated that the fact of the recommendations was of more value than the grant award.

The ratio of three dollars to one dollar is based on total funding for the Program and an output of approximately $6 million in grants. While Program costs have not been completely analyzed, but will be for "Sunset Review" purposes, it should be noted that well over $1 million was expended in activities providing other forms of support or assistance to inventors, rather than in evaluations, grant award, or administration. Further, the $6 million figure is derived as of March 31, 1981, and is low; updated to September 30, the figure is approximately $9 million. While we are not clear what the ratio proves, it nevertheless is significantly better than three to one.

IV. Comments on Mr. Reed's Recommendation

With respect to Mr. Reed's suggestion that the policy of OERI be to award a maximum amount of information to the inventor, this is the current policy subject to the constraint noted earlier. That is, the constraint that no information is developed solely to assist the inventor; but that information development is governed by the need to come to a decision on the technology. The program could be redesigned and services increased so as to increase service to the inventor, whether he has a worthwhile invention or not. However, this would result in increased costs without a significant return. We strongly favor improving access of information for the independent inventor as a means of stimulating innovation and have funded supplementary activities for this purpose as described in other submitted testimony. However, this should be done generically and not as a consultation service to identify what is wrong with an existing invention.

Mr. Reed recommends that the evaluation process focus on inventions in the earlier stages of development. This is now being considered with the view that funding should be justifiable only where long-term R&D is required. The choice now depends upon a redefinition of our role.

From the viewpoint that our role is to facilitate and encourage innovation where the private sector does not, evaluation may be justifiable regardless of stage of development. There are indications, to be verified in the program evaluation effort mentioned earlier, that many of the supported and successful inventions would not have been successful without a favorable OERI evaluation; in fact, with independent inventors and very small businesses there is a credibility factor which deters private sector support.

Mr. Reed recommends that our policy should focus on providing assistance to the independent inventor and that inventor or company needs should be a criterion in evaluation. Data presented earlier show that the independent inventor is the principal user and beneficiary of the program now. We believe that the current OERI policy, to focus on the inventions and not consider inventor or company needs or qualifications, is appropriate.

ATTACHMENT 1

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Paving the Way for Energy-Saving Innovations

by
David G. Jansson
and George C. Newton, Jr.

For inventors,
raising capital has always
been an especially difficult task.
But new assistance from the federal
government may help
them develop energy-saving innovations.

Imagine you're an inventor with an idea for a device or process that could save a great deal of energy while doing its task. You've figured out the capital required to produce a prototype product and calculated the return on investment that could be expected by users of your energy-saving innovation. What then? Your urgent problem is to find the venture capital to make it all happen.

Even if they have sound business plans, inventors often have trouble winning over venture capital organizations for financing. Venture capital firms have stringent criteria for investment, which include a "track record" for a product or products and a business plan to reasonably assure recovery of the capital with a substantial profit in a relatively short period. A return-on-investment factor of three to ten over a period of three to seven years is not an uncommon requirement. As a result, first-time inventors with an unproven technology typically have to obtain financing through friends and relatives or from wealthy individuals willing to take great risks.

Most inventors have difficulty finding capital after fashioning a crude prototype and before their inventions become attractive for investment by venture capital firms. The recent Energy-Related Inventions Program of the Department of Energy (DOE) is filling this gap to some extent with public funds.

The Legal Basis of Federal Grants to Inventors

The Federal Non-Nuclear Energy Research and Development Act of 1974 (Public Law 93-577) provides for "incentives, including financial awards, to individual inventors" to encourage participation in a national effort to develop more efficient means of producing and using energy. In response to PL 93-577, DOE has instituted the Office of Energy-Related Inventions (OERI) in the National Bureau of Standards (NBS). OERI evaluates disclosures submitted by inventors and recommends the best to the Office of Inventions and Small-Scale Technology in DOE for financial or other assistance. The law also addresses the need to assess the environmental and social consequences of any DOE-supported effort and to ascertain the likelihood of an inventor's obtaining private investment once DOE support has been exhausted.

The effort to assist individual inventors of energy-related devices differs significantly from more conventional government-sponsored research and development programs that strive to increase scientific knowledge and advance technology. This program more pragmatically focuses on stimulating the innovative process to assure that high-quality, energy-saving products and processes reach the

A market risk analysis of 41 inventions accepted for DOE support. (The number of inventions accepted for support has since risen to 128.) The 41 inventions are classified by major market area and are assessed for the degree of difficulty likely to be experienced when introduced into their respective markets. Note the reasonable balance in the allocation of awards with respect to the several market areas.

Major market area	Difficulty in Penetrating market	Number of positive award decisions
Industrial	low	15
Commercial	low	2
Agriculture	medium	2
Buildings	medium	11
Automotive	high	7
Appliances	high	1
Other	high	3
Total positive decisions as of December 31, 1978		41

marketplace and are assimilated into the economy. However, it is broad enough to embrace promising projects in basic research, product development, product demonstration, and business development. Minimally, the program aims to achieve at least one of the following specific objectives:

☐ To enable inventors to compete effectively for public or private contract support to obtain further development assistance.

☐ To enable inventors to form new enterprises to pursue production and marketing of their inventions.

☐ To help place inventors in a position to negotiate with existing companies for the commercialization of their inventions.

One of the unusual features of the DOE program is its encouragement to award recipients to transfer their new technology into the marketplace. In addition to giving financial support, DOE waives patent rights back to the inventor subject to a royalty-free license to the government, and the federal government is given the privilege of stepping in if the inventor fails to make progress on patenting and commercialization. Thus, the intent of Public Law 93-577 is fulfilled while the public is protected against an inventor's failure to transfer technology to the marketplace.

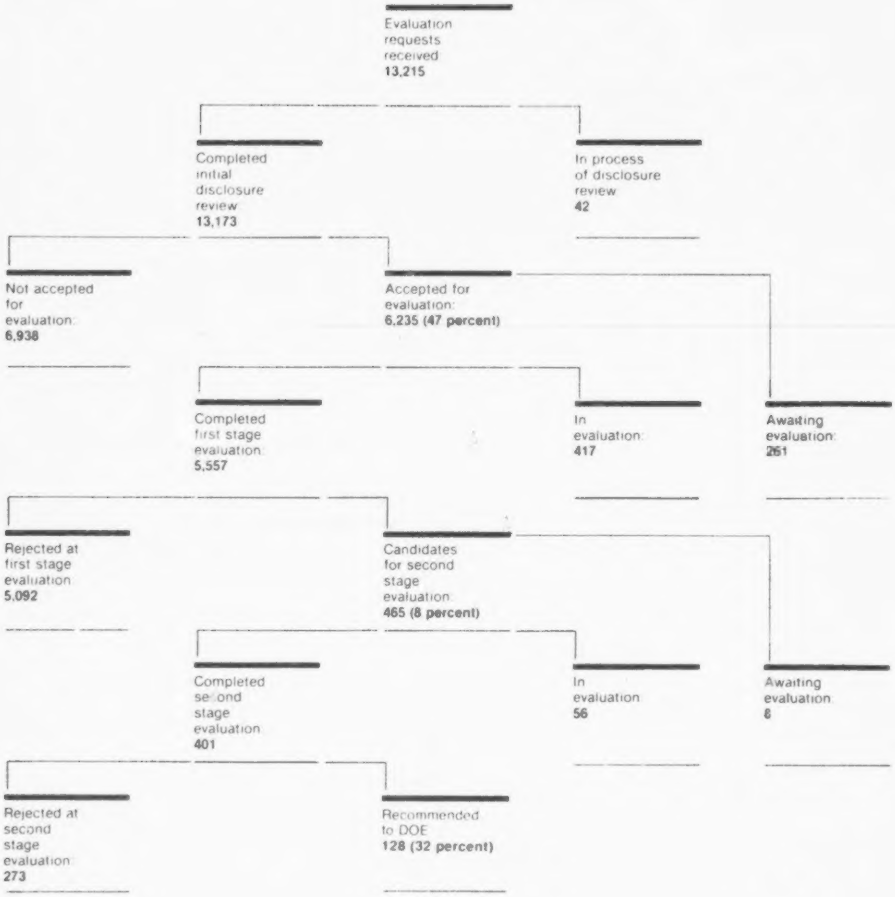
The Batting Average

As of December 31, 1979, the National Bureau of Standards had received 13,215 disclosures from individual inventors or their licensees; such disclosures are now arriving at a rate of about 70 per week. So far, the NBS has recommended 128 for the award of grants or contracts. Of these, support or assistance has been given to 65 and 6 others are in negotiation; 11 have been rejected by DOE and 46 are still under review. Of the 65 inventions that have received support or assistance, work has been completed on 17. The average award is approximately $65,000, excluding the value of government services available to some of the inventors.

At the request of DOE, the M.I.T. Innovation Center studied the results obtained under the program. The study started in fall, 1978 and ended in spring, 1979. Of necessity we had to focus on those inventions on which grant activity was either completed or quite far along. We selected from these a representative sample of five for detailed study. This sample includes innovations with both high and low potential for commercial success. We have found conclusively that the stream of invention disclosures does contain a significant number of worthy ideas, and that the societal return on those that eventually come into public use appears likely to repay the nation manyfold.

One criterion is energy conservation. In addition, there is an economic analysis of each invention that emphasizes the energy-related parameters of return on investment, defined as the net annual income or savings, after taxes, divided by the average capital investment. An investment return on the order of 20 percent typically is considered relatively good for low-risk investments; a return of less than 20 percent is likely to be unattractive unless other reasons override. Such reasons might include a special need for energy conservation because of limited energy

The results of the National Bureau of Standards (NBS) evaluation of 13,215 disclosures received from inventors through the end of 1979. DOE has found that about 1.3 percent of the disclosures can be expected to win funding: 47 percent accepted for evaluation × 8 percent accepted for "second-stage" evaluation × 32 percent recommended by NBS for DOE support.


Evaluation requests received 13,215
Completed initial disclosure review 13,173
In process of disclosure review 42
Not accepted for evaluation: 6,938
Accepted for evaluation: 6,235 (47 percent)
Completed first stage evaluation: 5,557
In evaluation: 417
Awaiting evaluation: 261
Rejected at first stage evaluation 5,092
Candidates for second stage evaluation: 465 (8 percent)
Completed second stage evaluation 401
In evaluation 56
Awaiting evaluation 8
Rejected at second stage evaluation: 273
Recommended to DOE 128 (32 percent)

A classification of 41 inventions accepted for DOE support prior to 1979 relating the number of grants to purpose of support and perceived technological risk. Note that reasonable balance was achieved for these two variables in the spectrum of awards.

Purpose of support	Technological risk	Number of positive award decisions
Basic research	High	2
Research and development planning		1
Applied research	Medium	12
Prototyping and/or testing		17
Estimation of performance and/or cost	Low	1
Improvement of an already marketed invention	Proven	2
Development of a business and/or financial plan		1
Assistance with marketing and/or development of market information		5
Total positive decisions as of December 31, 1978		41

availability, or the probability that return on investment will be much better in the near future because of decreased unit costs with increased market penetration. In addition, careful assessment of potential markets of an innovation is necessary.

Five Case Studies

We have studied in detail five innovations that have won DOE support and estimated the economic viability and energy impact of four. In each case we have reviewed:

☐ Estimates of the invention's possible energy impact.

☐ Assessments of the invention's business potential on the basis of energy-savings potential, estimated manufacturing costs, and the nature of the particular markets.

☐ Barriers to commercialization and the innovator's plans for transferring the new technology into the economy.

☐ The role and significance of DOE support in stimulating technology development and transfer.

A description of the five typical innovations and a summary of our findings follow.

Modification of the Flexaflo Dryer (DOE No. 56); Quality Industries, Inc. (licensee), Thibodaux, La.

This invention is a system for drying "wet" crop-processing wastes for use as fuels. Stack gases from a natural-gas-fired boiler are used as a source of heat to remove the moisture. The dried fuel is fed to the boiler, supplementing the natural gas. Formerly, wet fuel was supplied directly to the boiler, requiring much more gas. The initial application of this invention has been in sugar mills, which commonly use sugar cane residue, known as "bagasse," as a fuel.

In theory, the bagasse output of a sugar mill (about one-quarter ton wet waste per ton of processed cane) can supply all the mill's energy requirements. But the combustion of wet bagasse is less efficient than dry fuel and leads to boiler efficiencies of only about 50 percent.

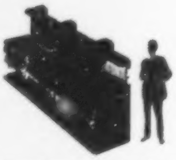
Before the DOE award was made, Quality Industries had designed, constructed, and installed three of these bagasse dryers. They performed so well that the need for gas was eliminated under steady operating conditions. Prior to the development of this form of dryer, typical Louisiana sugar mills required about 1,000 cubic feet of natural gas (producing about 1 million Btu's) to process 1 ton of sugar cane. This performance was far superior to that of two alternative drying methods: air-drying bagasse in storage (not very practical for large sugar mills that typically have capacities from 200,000 to 600,000 tons of cane per season), and preheating the air used for combustion with heat-recovery equipment energized by the stack gases.

Despite the promise of remarkable energy savings, Quality Industries had to overcome two major hurdles that required substantial development capital: the development and testing of a seal for the top of the dryer to prevent air from being carried into the system with the bagasse; and the development and testing of filter screen and scrubber systems to remove particulates (bagacillo) from the stack emissions. DOE granted $111,220 to the firm to overcome these problems, which also used about $500,000 of its own funds for the original development and these improvements.

The DOE award, which came in September 1978, enabled Quality Industries to improve the drying system at one sugar refinery so that operating results for half the 1978-79 season could be obtained. The modified installation proved to have even higher drying capacity than originally estimated, and in the opinion of Quality Industries it is a proven success. Unfortunately, relatively high U.S. labor costs have led to increased imports of low-cost foreign sugar. The potential market for these dryers in U.S. sugar mills (and other appropriate industries) is still sizeable — as are the potential energy savings. About 20 million tons of sugar cane are processed annually in the U.S.— about 10 million tons in Hawaii and 5 million tons each in Louisiana and Florida. However, the potential market in the Louisiana area for dryers has shrunk from over 35 four years ago to about 10 today.

The total supplemental energy that could be saved, based on 1 million Btu's per ton of sugar cane processed, is thus about 20 trillion Btu's per year — about 0.03 percent of total U.S. energy consumption. This small energy impact could be greater if the dryer were applied to other industries such as pulp and paper, municipal refuse, and the preparation of wood for firing utility boilers, as is contemplated in some New England states.

DOE funding was crucial to making the improvements to complete the development of this dryer — without this funding, the project would have been terminated. Its application to other industries needs to be explored because of the depressed state of the U.S. sugar industry.



Waste heat utilization for commercial cooking equipment (DOE No. 27); Robert J. Jones, Hydrocoil Manufacturing Co., Los Alamitos, Calif.

The Hydrocoil is a device that recovers low-grade heat from the flue gases of natural-gas-fired commercial cooking equipment. Water circulated through finned coils of tubing captures and transfers the heat to domestic hot water or ventilation air. Located within the flue, the heat recovery coil cannot be fouled with hot grease and so can be used only with cooking units such as ranges with griddle tops, hot tops, or deep fat fryers. The entire system is fabricated from standard hardware and equipment using skills similar to those needed for plumbing and the installation of commercial cooking equipment. There are no significant technological problems to be solved in the development of the product.

Support from the Department of Energy enabled the inventor to fabricate one prototype device for preheating water and one for preheating air. These are being evaluated by Calspan Corp. and the American Gas Association. Independently, the inventor has installed a Hydrocoil in a California restaurant with instrumentation to measure in-service performance. The resulting data will be very valuable in understanding the impact of this invention.

With continuing increases in energy costs, the Hydrocoil could become a good energy conservation investment for many businesses around the country. With 100,000 installations each recovering 125,000 Btu's per hour for 18 hours per day, 48 billion cubic feet of natural gas could be saved annually. At 1 million Btu's per 1,000 cubic feet, the savings would amount to a significant 0.06 percent of U.S. energy use.

Direct-flame-contact high-efficiency water heater (DOE No. 53); Harry E. Wood, New Orleans, La.

Mr. Wood's water heater design is about one-third more efficient than conventional gas-fired water heaters of similar output; it heats water by bringing the gas flame and combustion products into direct contact with the water. The combustion rate and the water flow rate are adjusted so that the water reaches the desired temperature in a single pass through the unit. Heated water is stored in a reservoir at the bottom of the tank assembly. A forced draft mixes air and gas prior to combustion and drives the flame through the heat-transfer region. Stack temperatures are very near the temperature of the inlet water — evidence that the efficiency of this heater is substantially greater than that of conventional gas-fired water heaters, whose stack gas temperatures are well above the boiling point of water at atmospheric pressure.

Conventional water heaters also lack the ability of Mr. Wood's heater to recover the latent heat of vaporization contained in the water vapor formed during the burning process.

Mr. Wood built a small water heater and tested it in his own home prior to receiving a DOE grant in May 1978. The grant enabled him to build a commercial-size unit capable of heating 50 gallons of water per minute (equivalent to 2.4 million Btu's per hour) and to install it in a 210-unit apartment complex. The performance of this heater has been so good that Mr. Wood has obtained orders for eight commercial-size water heaters (with an output ranging from 2 to 23 million Btu's per hour). He has received additional orders to make modified units to recover waste heat from boiler stacks.

Mr. Wood's water heater design has stabilized, and he has obtained safety approval from the Factory Mutual Engineering Research Corp. for the components and statements from an independent testing laboratory and the Louisiana Board of Health that the water from it is fit for human consumption. Should similar approval not be won in other states, there is still considerable market potential for this type of water heater in the food-processing and laundry industries and as a replacement for conventional boilers in hot-water space-heating systems. Mr. Wood is considering joint-venture possibilities with larger organizations to supply such potentially large markets. He does not consider the single-residence home market attractive because the heater controls are quite expensive, putting his design at a disadvantage against small, conventional heaters.

The economic prospects for the direct-contact heater depend strongly on whether potential buyers can be persuaded that it will yield a favorable return on investment. Over a 10-year life, the heater would produce a rate of return of 18.8 percent on the extra capital needed to install it (instead of a conventional gas-fired unit), producing a payback period of about 5.3 years (without tax incentives and using a 1978 gas rate of $2 per million cubic feet; this rate is more nearly $3 per million cubic feet as of 1980). This estimate, adjusted for the rapidly increasing gas rates, suggests that the direct-contact heater may be competitive chiefly in regions with higher-than-average energy costs. New England would seem to be an especially good potential market area.

The somewhat greater complexity of the control system could be a minor barrier to commercializa-

Return-on-investment estimate for the bagasse dryer, based on a 200,000-ton-per-season plant, the minimum size for economical operation. Such a plant in Louisiana or Florida would be onstream 1,500 to 1,800 hours per season. A Flexaflo dryer for such a plant would cost about $300,000, plus $50,000 for installation. Straightline depreciation is used and a 10-year life is assumed. The effects of any available tax credits are not considered.

Annual energy saving		$400,000
Annual expense		58,000
Labor	$10,000	
Repairs & maintenance	6,000	
Taxes & insurance	7,000	
Depreciation	35,000	
Annual expense saving		$342,000
Income taxes at a 50-percent rate		(171,000)
Change in net profit after taxes		$171,000
Average annual capital investment		$175,000
Annual return on average investment		98 percent

tion. Some special training will be needed by service people, although the system is assembled from standard components.

Widespread use of direct-contact water-heating technology could save considerable energy. The energy consumed by commercial-size gas-fired water heaters is about 2.3 percent of total U.S. energy consumption. This estimate is based on gas-fired water heaters having 80 percent penetration of the commercial market, 50 percent of the apartment market, and industrial use comparable with commercial use. If the quality of the hot water produced by direct-contact water heaters is accepted generally as potable, and all these users convert to direct-contact water heaters, savings could come to an impressive 0.6 percent of total U.S. energy consumption.

Wastewater aeration power control device (DOE No. 47); Robert M. Arthur, Arthur Technology, Fond du Lac, Wis.

This invention can help save energy in wastewater treatment plants. It senses and measures the biological oxygen demand created by microorganisms that break down activated sludge. Its use would help make possible a reduction in the excess air needed in the treatment plants. Currently, the compressors that force air into treatment tanks run constantly, even when oxygen is not needed; the energy savings would result from running them only when necessary. Mr. Arthur developed the basic concept for his sensor several years ago and has been selling versions suitable for laboratory use. The sensor isolates and aerates a sample of wastewater and then measures the vacuum created as the microorganisms consume the limited oxygen. It also scrubs out the carbon dioxide produced by the microorganisms to prevent their premature demise.

The DOE grant enabled the inventor to develop a cheaper, less-sophisticated model of the sensor that would be suitable for large-scale use in wastewater treatment plants. The firm is now testing and calibrating the first such instrument in a wastewater environment and plans to build, install, and test five additional instruments. Test results will be used to fine-tune the design, after which Mr. Arthur envisions marketing through his company's existing channels.

A comparatively brief payback period, based on energy savings of approximately 25 percent of the electrical power now being used for aeration, enhances the promise of economic viability for this product in both small and large wastewater plants, including those used industrially. Very conservative estimates indicate that the device will pay for itself in only one to two years when used in activated sludge treatment plants that process less than 5 million gallons of wastewater per day. Use by plants with larger treatment capacity could result in an even brighter economic picture. Of course, these estimates assume the concomitant use of compressors suitable for modulated control.

Projected national energy savings are equivalent to 2.2 million barrels of oil per year, based on combined 1977 energy consumption figures for all U.S. municipal activated sludge wastewater treatment plants. Projecting future growth, including industrial wastewater treatment, use of this innovation could save about 22 million barrels of oil per year by 1990.

Conservation of electrical power through the analysis of low-carbon aluminum steels using oxygen sensors and iron aluminum alloy (DOE No. 18), George R. Fitterer, Fitterer Engineering Associates, Inc., Oakmont, Pa.

The liquid steel produced in a basic oxygen furnace contains a considerable quantity of oxygen that must be removed before solidification. One method of doing this is the addition of aluminum to the melt, where it bonds chemically with the dissolved oxygen. About 20 percent of the steel made in the U.S. is treated in this fashion. This DOE-funded project is a patented oxygen sensor called an "O-Probe," which may help to save energy by providing more precise control of aluminum "trim."

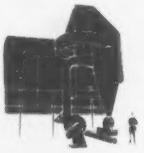
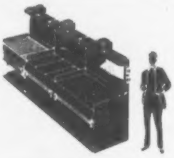
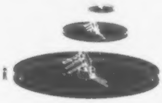
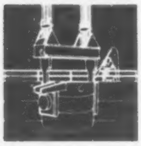
The quality of low-carbon, aluminum-killed (LCAK) steel in each individual melt depends on adding just the right amount of oxygen-absorbing aluminum. Operators now make this judgment by observing subjectively certain characteristics of the melt. Though samples of steel are sent to the laboratory for analysis, test results do not come in time to be used in a determination of how much aluminum should be added. If a particular melt of steel contains too much aluminum or not enough, then it is considered an off-grade melt and either sold at discount as lower-grade steel or scrapped. The imprecision of this technique entails losses of the energy required to melt the steel and produce the aluminum. (About 3.5 times as much energy is needed to produce a pound of aluminum as to produce a pound of steel.)

In principle, the O-Probe, a zirconium sensor that quickly measures the oxygen content of steel, should provide the information needed in time to optimize the addition of aluminum. But the aluminum-oxygen equilibrium in steel is not well understood, and control is difficult because of aluminum's low density and its high reactivity in liquid steel. Aluminum reacts vigorously with the air and the slag on top of the melt as well as with the oxygen dissolved in it. These side reactions greatly complicate the prediction of the final aluminum content of LCAK steel. As a result, the use of the O-Probe has not been as rewarding as hoped. (Fitterer Engineering Associates is currently evaluating the use of an aluminum alloy that is denser than pure aluminum and may reduce the side reactions of aluminum with air and slag.)

DOE continues to support work on the O-Probe in the hope that its use can reduce both scrappage and intrinsic energy loss. Fitterer Engineering Associates, in cooperation with McLouth Steel Corp. of Trenton, Mich., has used O-Probes at various stages in the steel-making process to obtain data on the reactions that take place during the production of steel. The study resulted in a clearer conception of the deoxidation process and the amount of aluminum lost, and it also demonstrated that the O-Probe may be useful near the end of the steel-making procedure to predict steel quality. A rough correlation was found between the steel's oxygen content just before being "tapped" into a ladle and its final aluminum content, but the correlation is weak and needs further study.

This project is a good example of a longer-range research and development task supported by the DOE program that will not immediately produce a marketable result. Economic conditions in the U.S. steel-making industry tend to discourage investments in innovative technology. Without the en-

Summary of characteristics of 5 inventions selected by the authors from the list of 41 inventions that successfully won DOE support before 1979. Of these 5, only the O-Probe, a device to optimize energy use in the manufacture of low-carbon aluminum-killed steel, is still too early in development to provide return-on-investment and return-to-society data

	Invention	Technological level and stage of development at time of DOE grant	Stage of development at end of grant	Estimated return on investment	Est energy saving Bbl oil/year equivalent. Percent U.S. total energy usage	Est societal return Present value of energy saved – grant amount	Market success prospects
	**Wet solid fuel dryer**	Low, advanced	Substantially ready for marketing, production facility available	Approximately 98 percent per year in cane sugar industry	3.2 million, 0.03 percent	4,500	Uncertain because of depressed state of cane sugar industry, other markets need to be explored
	**Waste heat recovery from commercial cooking**	Low, advanced	Substantially ready for marketing, production yet to be arranged	Satisfactory for applications with a high product of load factor times gas price	7.8 million, 0.06 percent	18,000	Some regions of the country offer good market, other regions are uncertain
	Direct-contact water heater for commercial use	Low, midway	Substantially ready for marketing, production yet to be arranged	Greater than 19 percent per year, satisfactory for a substantial part of market	70 million, 0.6 percent	150,000	At least half of potential water heating market should be obtainable, space heating market needs to be explored
	**Waste-water aeration control**	Medium, early in redesign phase	Prototype ready for testing and calibration	1 to 2 year payback for small municipal plants, shorter for larger plants	4.4 million, 0.04 percent	12,000	Good for new plants, uncertain for existing plants
	**Control of LCAK steel production**	Medium, early	Further studies being conducted	•	•	•	Effectiveness still not proven

couragement and support of DOE, it is unlikely that Fitterer Engineering Associates and McLouth Steel Corp. could have continued this work.

Some Positive Observations

The value of the DOE Energy-Related Invention Program to U.S. energy conservation goals is clear, even judging only by the five projects just described. The first four inventions have been brought very close to marketable form or have actually been marketed. The economic effectiveness of all four appears to be satisfactory or high. Their combined estimated energy-saving potential is significant, and the energy-saving potential of the direct-contact water heater is impressive.

In the first case, production facilities already exist; the only remaining problem is encouraging a depressed industry to invest in this energy-saving equipment. Further progress will depend on economic recovery in the sugar industry or the development of other markets for the dryer. The direct-contact water heater project has already had some market success, and the inventor has just recently licensed a major manufacturer of water heaters to continue commercialization. For the next two cases, production and final marketing arrangements remain. The fifth case requires more research and development. But should it be perfected, the public investment in its support will be paid back manyfold.

These conclusions, combined with information gathered from interviews with the inventors, provide the basis for the following positive appraisal of the Energy-Related Inventions Program:

☐ It provides one of the few funding channels through which inventors can receive an objective hearing. This open channel stimulates innovative activity by inventors and small businesses.

☐ The stream of invention disclosures has been conclusively shown to contain a significant number of worthy ideas.

☐ The evaluation process used by NBS and DOE is effective in selecting particularly promising inventions.

☐ The support given to inventors has made the difference between successful development and termination of many projects.

☐ The initial indications, even if only a few of the funded projects successfully transfer to the marketplace, are that the societal benefits in terms of energy saved (and in terms of taxes earned on new profits generated) will more than repay program costs.

How to Improve the Program

As successful as the Energy-Related Inventions Program is, improvements are certainly possible in several areas.

From the inventor's viewpoint, NBS and DOE take too long to respond to an evaluation request. The combined time for these reviews may be a year or more between the submission of a disclosure and the awarding of a grant to the successful inventor. (Inventors inadvertently may contribute to this delay with less than prompt responses.) Both NBS and DOE are working to reduce this time lag.

Consideration could be given to enabling repayment of grants through small royalties in the event of commercial success. Over time, these royalty payments could be used to partially defray the program's cost or to permit the funding of additional "higher-risk" inventions.

Although not currently a function of the Energy-Related Inventions Program, a follow-up program could be organized to monitor progress after funded work has been completed, and to refer inventors to other funding offices or agencies when appropriate. (To some extent this is already being done informally.)

The government might consider further aid to an inventor beyond a specific grant. Such aid might be in the form of counseling to develop business and marketing plans to help ensure the transfer of the technology to the marketplace.